

ENVIRONMENTAL PROTECTION AGENCY

PUBLIC HEARING

ON

NATIONAL EMISSIONS STANDARDS

FOR HAZARDOUS AIR POLLUTANTS

at the

Courtroom #2

1 Federal Plaza

New York, N. Y.

P r e s i d i n g :

WILLIAM H. MEGONNELL

Director

Division of Stationary Source Enforcement

Environmental Protection Agency

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\* \* \*

P R O C E E D I N G S

MR. MEGONNELL: The hearing will please come

to order.

My name is William Megonnell, Director of

the Division of Stationary Source Enforcement in the

Environmental Protection Agency, and I have been designated

by the Administrator as Presiding Officer for this hearing.

My colleague is Mr. Robert Baum, Assistant General Counsel

and Director of the Air Quality and Radiation Division of

EPA's Office of Enforcement and General Counsel.

Several other representatives of the Environ-

mental Protection Agency will participate in the proceedings.

They will be appropriately identified at the time of

appearance.

For the record, this hearing is convened on

January 18, 1972, at United States Customs Court, 1 Federal

Plaza, New York, New York. I will submit for insertion

in the record at this point, as it read, a copy of the

December 16, 1971, Federal Register notice calling the

hearing.

Now, a brief explanation of what the

hearing is all about and the rules that will apply. They

emitted to the ambient air, may cause, or contribute to, an increase in morbidity or an increase in serious mortality, or incapacitating reversible illness; and, if so, (2) what standards should be adopted to regulate emissions of such pollutant. The Administrator requested, in Section 112, to establish standards at the level which in his judgment would give an ample margin of safety to protect the public health from any known or suspected pollutant, unless, on the basis of information presented at the hearing, he finds that such pollutant does not constitute a hazardous air pollutant. According to participants in the hearing, he requested to identify specific health protection of their presentations, in connection with the issue of whether the pollutant in question meets the definition of a hazardous air pollutant, as defined in section 112(b)(1) of the Act.

Mr. William H. D'Amico, formerly designated Presiding Officer for the hearings. He will have the responsibility for maintaining order; excluding irrelevant or repetitious material; scheduling presentations; and, to the extent possible, notifying participants of the time at which they may appear. The hearings will be conducted informally. Technical rules of evidence will not apply.

Persons wishing to make a statement at a hearing are requested to file a notice of such intention not later than 15 days prior to the appropriate hearing and, not later than 10 days prior to the appropriate hearing, if practicable, to submit five copies of the proposed statement to the Administrator of the Environmental Protection Agency, Attention: Presiding Officer, Hazardous Air Pollutants Hearings, Rm. 17-70, 3600 Fishers Lane, Rockville, Md. 20852.

Dated: December 12, 1971.

WILLIAM D. TRACY, DEPUTY  
Administrator.

[EPA Doc. 71-18191 Filed 12-13-71; 3:31 am]

## ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 61]

### NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

#### Notice of Public Hearings

Section 112(b)(1)(C) of the Clean Air Act, as amended by Public Law 91-604, directs the Administrator of the Environmental Protection Agency to publish proposed regulations establishing emission standards for hazardous air pollutants together with a notice of public hearing. Such regulations for asbestos, beryllium and mercury were proposed in the December 7, 1971, issue of the Federal Register at page 23379.

Notice is hereby given of public hearings concerning the proposed hazardous emission standards to be held at the following dates, times and places:

January 16, 1972, beginning at 10 a.m. est.,  
U.S. Customs Court Building, Courthouse  
No. 2, Room 461, 1 Federal Plaza, New York,  
NY;

February 1, 1972, beginning at 10 a.m. est.,  
The Midtown Building, Room 113, 1755 Bal-  
timore Street, Room 113, City, MD.

February 15, 1972, beginning at 10 a.m. pac.,  
U.S. Courthouse, Room 104, 312 North  
Spring Street, Los Angeles, CA.

The hearings are intended to provide opportunity for interested persons to state their views on proposed hazardous emission standards for asbestos, beryllium, or mercury, which

will be kept as simple as possible consistent with orderly

proceeding.

Section 112 of the Clean Air Act as amended,

1970, defines a hazardous air pollutant as one that may

cause or contribute to an increase in mortality or an

increase in serious irreversible, or incapacitating revers-

ible, illness. The Administrator of the Environmental

Protection Agency was required, within 90 days after the

enactment of the law, to publish a list of hazardous air

pollutants for which he intended to establish emission

standards. Such a list of pollutants, including asbestos,

beryllium, and mercury, was published in the Federal

Register on March 31, 1971. Proposed emission standards

for the three pollutants were published in the Federal

Register on December 7, 1971. The statute provides that

not later than 180 days after the publication of the pro-

posed standards, the Administration shall prescribe an

emission standard for each such pollutant unless he finds

on the basis of information presented at public hearings

that such pollutants clearly is not a hazardous air

pollutant.

The basic purpose of this hearing, then, is

to allow opportunity for interested persons to comment on

whether or not asbestos, beryllium and mercury are in fact hazardous air pollutants within the definition set forth in the statute. The standards for these pollutants have been proposed and will be promulgated under procedures prescribed for all standards under the Federal Administrative Procedure Act, i.e., the standards are proposed, written comments on the standards are accepted and, after consideration of the comments, the standards are promulgated. The same process is being followed with regard to hazardous emission standards. Comments are now being received on the proposed standards. But in the case of hazardous emission standards, Congress provided for additional public participation by requiring hearings.

As I said, the basic purpose of this hearing is to allow public comment on the Administrator's initial decision to include each of the pollutants on the list, rather than to comment on the standards themselves; nevertheless, in the interest of increasing the opportunity for public participation in the entire rule-making procedure, the Environmental Protection Agency will permit presentations concerning the proposed standards as well as those relating to the question of whether or not the pollutant is in fact hazardous. Accordingly, we request that all participants



specifically identify the nature of their statements. That is, either state that all or part of their presentation has to do with whether or not the pollutant is hazardous, or indicate that the comments are not directed at this question but are concerned only with the proposed standards for the pollutants.

Since today's hearing is not a rulemaking

hearing under the Administrative Procedure Act, no formal procedures or rules of evidence will apply. Participants may submit any additional materials which they feel should be brought to the attention of the Administrator. For

this purpose, the record of the hearing will be kept open for one week following adjournment. The presiding officer retains the right to limit presentations to the issues at hand; namely, (1) are the pollutants hazardous, and (2)

do the proposed standards protect, with an ample margin of safety, the public health from the effects of the pollutants? Accordingly, the presiding officer may limit the oral

presentation if not pertinent to the matters at hand, and may ask that redundant or corroborative material be submitted rather than read. In addition, I should state that

written materials may be submitted directly to EPA, outside the confines of this hearing record, for the full 90-day

period allowed from the date of publication. The comment period ends on March 6, 1972.

A verbatim transcript is being made, and this will be the sole official record of the hearing. Persons desiring to purchase copies of the record should make arrangements with the reporter during one of the recesses.

We have received requests from several persons who wish to appear. If there are any others who have not made their wishes known, please contact Mr. Edward Reich as soon as possible so that appropriate scheduling may be arranged.

In order to get into the record initially some of the thinking which entered into the Administrative decision I have asked a representative of our medical research group in the Environmental Protection Agency, Dr. Robert J.M. Horton, to present brief individual statements on each of these pollutants. Dr. Horton.

MR. MOERMAN: Mr. Examiner, my name is S.H. Moerman. I am counsel for the Chlorine Institute, Inc. May I ask if you would say just one more word before Dr. Horton begins about the matter of this hearing not

being directed to rulemaking? I am not sure I got that.

MR. MEGONNELL: I will let my general counsel

representative answer that, sir.

MR. BAUM: This is not subject to any formalities under the Administrative Procedure Act. This is part of the record on which the Administrator will eventually promulgate the rule, assuming he does not find that the pollutant is not hazardous.

The regular rulemaking procedures are being followed; that is, the proposal and the comments, and this hearing essentially goes to the question rather than what level the standards should contain, it essentially goes to the question of whether or not the pollutant is hazardous.

MR. MOERMAN: And the representations, if any, with respect to the other subjects that have been covered in an invitation to submit in writing; is my understanding correct?

MR. BAUM: Yes, whatever is said here will also be considered along with those comments. It is simply that no procedural formalities are going to apply to this hearing, that is all.

MR. MOERMAN: I appreciate that very much. It clears it up for me. Thank you, Mr. Examiner and Mr. Baum.

MR. MEGONNELL: Dr. Horton.

STATEMENT BY  
DR. ROBERT HORTON  
UNITED STATES  
ENVIRONMENTAL PROTECTION AGENCY

DR. HORTON: I am Robert J. M. Horton, M.D. medical advisor in the office of the National Environmental Research Center, Research Triangle Park, a unit of the Environmental Protection Agency.

MR. HEGONNELL: Could you please speak into the microphone.

DR. HORTON: The first statement I will read is on asbestos.

HEALTH HAZARDS OF AIRBORNE ASBESTOS

The following statement is a brief summary of those aspects of the toxicology of asbestos which establish it as a hazardous air pollutant. A hazardous air pollutant is defined by section 112 of the Clean Air Act of 1970 as one: "to which no ambient air quality standard is applicable and which in the judgment of the Administrator may cause, or contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness."

The diseases which have been related to the

inhalation of asbestos by humans include asbestosis and malignant tumors of the lung, pleura and peritoneum. Of these, asbestosis was the first to be associated with exposure to asbestos. Asbestosis is a non-malignant lung disease which results in an X-ray pattern of diffuse interstitial fibrosis and physiologic changes consistent with a restrictive lung disorder. The disease is often lethal in severe cases. However, prolonged exposure to asbestos concentrations far above those likely to be found in community air is required to produce clinically significant (i.e. incapacitating) asbestosis.

An association between asbestos exposure and carcinoma of the lung was first firmly established by epidemiologic evidence reported in 1947. The data indicated that bronchogenic carcinoma was present in 13.2 percent of 235 persons known to have died with asbestosis. In the years since 1947, numerous other studies have confirmed this relationship between asbestos exposure and lung cancer. One study showed that asbestos workers who smoke are 92 times as likely to develop lung cancer as non-asbestos workers who do not smoke. (Should exposures in the general population approach those in occupational situations a considerable increase in mortality and

morbidity of lung cancer could be produced.) However, whether nonoccupational exposures to asbestos play a role in the development of bronchogenic carcinoma has not been adequately studied. The Panel on Asbestos of the National Academy of Sciences has evaluated the existing literature on asbestos. According to their review the only tumor associated with nonoccupational asbestos exposure is diffuse mesothelioma.

Mesotheliomas, primary malignant tumors of the pleura and peritoneum, however, are serious. In 1960 Wagner et al. reported 33 cases of pleural mesothelioma from South Africa. A history of asbestos exposure was established for all but one patient. Only 17 of these were occupationally exposed. The remaining patients lived in the vicinity of an asbestos mine or had household contacts with miners. Numerous other reports linking mesothelial malignancies to asbestos exposure have been published since 1960.

This argues strongly for a causal association. Thus several types of exposure to asbestos have been associated with mesotheliomas including: 1) occupational exposure to asbestos, 2) employment or residence near an asbestos industry, 3) household contact with an asbestos

worker, and 4) no known exposure. For example, Newhouse and Thompson reviewed a series of 83 patients whose mesotheliomas were diagnosed at the London Hospital between 1917 and 1964. The authors were able to obtain full occupational and residential histories for 76 patients in the series. They found that 31 (40.8%) had occupational exposures to asbestos, 9 (11.8%) lived in the same house as an asbestos worker, 11 (14.5%) had no history of occupational or household exposure but lived within half a mile of an asbestos factory and 25 (32.9%) had no known exposure. Of the 25 with no known exposure, four were found to have asbestos bodies in their lungs. Corresponding percentages for a group of matched control subjects were: occupational exposure - 10.5%, household exposure - 1.3%, neighborhood exposure - 6.6%, and no exposure - 81.6%. These findings strongly implicate asbestos as a causal factor in this disease.

Many case reports of mesothelioma include persons who have worked in the shipbuilding and construction industries at jobs that do not involve direct contact with asbestos. Thus, it is apparent that indirect occupational as well as nonoccupational exposure to asbestos may contribute to the development of mesothelioma. Accurate

characterization of previous asbestos exposure in individuals who subsequently develop mesothelioma is difficult because of the prolonged latent period between exposure and the onset of the disease. The prognosis of malignant mesotheliomas is extremely poor. In one large series of malignant mesotheliomas the average duration of life following the onset of symptoms was only 16.4 months.

In conclusion, the Panel on Asbestos of the NAS has stated: "Because of the known serious effects of uncontrolled inhalation of asbestos minerals in industry and uncertainty as to the shape and character of the dose-response curve in man, it would be highly imprudent to permit additional contamination of the public environment with asbestos. Continued use at minimal risk to the public requires that the major sources of man-made asbestos emission into the atmosphere be defined and controlled. In the absence of such controls, local fiber concentrations might at times approach those in occupational sites. Analytic methods and epidemiologic data are not yet adequate for the development of an ambient air standard, but emission controls are needed and appear to be feasible."

Do you have any questions?

MR. MEGONNELL: I can't think of any at



this time.

DR. HORTON: Thank you.

Next I will read the statement on beryllium. The first paragraph simply repeats the first paragraph in the previous document and I can't read that.

HEALTH HAZARDS OF AIRBORNE BERYLLIUM

Acute and chronic forms of lung disease are known to result from the inhalation of certain beryllium compounds. The first of these to be recognized was an acute inflammatory reaction in the respiratory tract of man. Only water soluble compounds of beryllium cause this inflammatory response in the upper respiratory tract. However, many insoluble beryllium compounds and the pure metal, in addition to the soluble compounds have been implicated as causes of acute pneumonitis.

The course of acute beryllium-induced pneumonitis depends upon exposure levels. Overwhelming acute pneumonitis progressing to pulmonary edema and death may result from inhalation of heavily contaminated air. Exposures to lower concentrations of beryllium (100 - 400 ug/m) may cause an illness with insidious onset, characterized by non-productive cough; substernal pain; fatigue; weight loss; and the subsequent appearance,

1-3 weeks after initial symptoms, of a hazy chest X-ray pattern. Provided that the beryllium exposure is terminated, complete recovery usually occurs in 4-12 weeks. (3) With one reported exception, (4) this form of beryllium-induced lung disease has occurred only in workers who were occupationally exposed to beryllium.

Chronic forms of beryllium-induced pulmonary disease can be caused by both acute and chronic exposures. This disease, known as berylliosis, is characterized by a progressive, granulomatous process located in the interstitial tissue and alveolar walls. Most cases of berylliosis follow exposure to insoluble beryllium compounds. (5) A prolonged latent period between the time of exposure and the onset of symptoms often occurs. Half the reported cases have been symptomatic at least one year after exposure was terminated. (6) Symptoms of chronic beryllium disease are similar to those of the acute disease (shortness of breath, non-productive cough, chest pain, fatigue, and weight loss). However, unlike acute beryllium disease, the chronic form has a prolonged progressive course, and systemic manifestations such as enlargement of liver or spleen and kidney stones have been reported. (7)

Berylliosis has occurred in individuals who

have never been occupationally exposed to beryllium. Of the 60 cases of non-occupational disease on file with the Beryllium Registry, 27 resulted from washing clothes soiled with beryllium dust. Another 18 followed exposure to beryllium air pollution in the vicinity of beryllium plants and 13 involved exposure to a combination of polluted air and contaminated clothing; exposures in the remaining 2 cases were unknown. (8) This disease has been fatal in approximately half of the individuals with non-occupational berylliosis. (9)

Most reported cases of berylliosis have resulted from exposure to beryllium at a time when its hazard was not recognized and its concentration in the air not measured. Attempts to estimate beryllium exposure levels among people with non-occupational berylliosis have been made. Based on these estimates: "It may therefore be concluded that the lowest concentration which produced disease was greater than 0.01 micrograms per cubic meter and probably less than 0.10 microgram per cubic meter." (10)

In 1949, limits for the concentration of beryllium and its compounds in community air were included in AEC contracts. A limit of 0.01 ug/m<sup>3</sup> calculated as a monthly average, at breathing height, was set. In the

twenty years since this guideline was established, there have been no reported cases of chronic beryllium disease resulting from community exposure.

The Committee on Toxicology of the National Academy of Sciences stated in 1966 that: "the level of 0.01 ug Be/m<sup>3</sup> currently used as a guide for protecting the neighborhood population from undue exposure to beryllium materials in the effluent from industrial plants has been effective in controlling beryllium disease." (11)

MR. MEGONNELL: Dr. Horton, is berylliosis a type of disease, or are the symptoms so distinct that a physician other than a specialist would be likely to recognize and distinguish them from other chest diseases?

DR. HORTON: Probably not. It resembles a number of other illnesses. I think that diagnosis in most cases would probably require referral to a specialist who is accustomed to this.

MR. MEGONNELL: That is what I was wondering about. I imagine in areas of beryllium processing plants that the local physicians would tend to be more vigilant for this type disease.

DR. HORTON: Yes.

MR. MEGONNELL: The run-of-the-mill general

practitioner, if there is such a thing, in Brooklyn, might not be looking for it; is that likely?

DR. HORTON: Well, he wouldn't be looking for it. But also, his ability to recognize it would be somewhat limited. I would think he might want to refer it to a pulmonary specialist.

MR. MEGONNELL: But in any event, the facts are such that there has been no reported incidents since the AEC specification?

DR. HORTON: So far as I know, this is correct.

MR. MEGONNELL: All right, you may proceed with your mercury statement.

DR. HORTON:

#### HEALTH HAZARDS OF AIRBORNE MERCURY

Although mercury has long been known as a poison, its potential as an environmental pollutant has only recently been recognized. Of the various forms of mercury, methylmercury is of central concern with respect to the health of the public. This follows from the facts that: 1) inorganic mercury which reaches the waterways can be metabolized by microorganisms to methylmercury, 2) methylmercury is soluble in water and is concentrated

a factor of several thousand in fish and shellfish, 3) consumption of these aquatic forms may result in human poisoning. Airborne mercury is a hazard to the health of the public insofar as: 1) it may move through the environment and serve as a source for the production of methylmercury, 2) mercury which is inhaled may add to the toxicity of methylmercury, the primary source of which is the diet.

There have been two epidemics of methylmercury poisoning in which contaminated seafood was the source of the mercury. Both of these outbreaks occurred in Japan in areas adjacent to industries which discharged mercury compounds into the waterways. Poisoning was manifested primarily by signs and symptoms of central nervous system dysfunction. These included numbness and tingling of the extremities, mouth and lips; concentric loss of the visual fields, sometimes progressing to blindness; neurogenic hearing loss; unsteadiness of gait; loss of coordination; changes in reflexes; and in the more severe cases loss of speech and progressive dementia. The case fatality rate in the epidemics ranged from 13-38 percent, and the survivors were usually permanently disabled.

A number of infants and children were affected with a cerebral palsy-like illness during the epidemic in Minamata. The disease was characterized by mental retardation and motor disturbances. It is likely that most of these infants were poisoned prenatally. Although there are no data on the exposure to methylmercury of the mothers of the affected infants, it is known that the cases occurred in families which consumed large quantities of fish.

Retrospective examination of these mothers revealed that some had symptoms compatible with methylmercury poisoning during pregnancy. However, none of the mothers were sufficiently symptomatic while they were pregnant to arouse suspicion of poisoning. Thus, it is apparent that pregnant women can be exposed to amounts of methylmercury sufficient to permanently damage (or

eventually kill) their unborn children without developing any warning symptoms. Potential "silent" hazardous effects of mercury upon human cellular systems must therefore be suspect. Investigations conducted since the epidemics have shown that methylmercury crosses the placenta and is present in a 30% higher concentration in fetal red blood cells than in maternal red blood cells. Possible teratogenic

effects are thus a definite concern.

Methylmercury is known to affect genetic material in at least three ways. First, it has been shown to interfere with the mitotic spindle in plants, lower animals and human leukocyte cultures. Second, it causes chromosome breaks. One study has shown a correlation between the level of methylmercury in the blood and the frequency of chromosome breakage in human lymphocytes. Finally, it is known that it can cause mutations in lower animals.

An analysis of the Japanese epidemics by a Swedish expert group led them to conclude that an adult sensitive to methylmercury would be poisoned by an intake of about 4 ug/kg body weight/day. Application of a safety factor of ten yielded an acceptable exposure of about 0.4 ug/kg body weight/day or 30 micrograms/day for a 70 kilogram man. It was felt by the expert group that application of this safety factor provided satisfactory protection against poisoning of the fetus, genetic lesions and poisoning of children.

Evaluation of the intake of atmospheric mercury requires consideration of the contribution of mercury from water and food. It is believed that most



mercury compounds in the atmosphere degrade to elemental mercury when exposed to sunlight. Thus, it can be assumed that exposure to atmospheric mercury represents exposure to mercury vapor. It is known that humans absorb between 75 and 85 percent of inhaled mercury vapor when concentrations vary between 50 and 350  $\text{ug}/\text{m}^3$ . Experiments in mice have shown that lower concentrations of mercury vapor may be more completely absorbed.

At this time there are no studies known to us which establish the relative toxicity of methylmercury and mercury vapor. However, comparison of the smallest average daily doses of the two forms of mercury which have produced symptoms shows that they are similar. For methylmercury, a dose of 300  $\text{ug}/\text{day}$  caused symptoms of poisoning in a sensitive adult. The corresponding dose for mercury vapor can be similarly estimated. Some industrial workers chronically exposed to about 100  $\text{ug}/\text{m}^3$  of mercury vapor have subtle symptoms of poisoning. Assuming inhalation of approximately 10  $\text{m}^3$  of air during the working day, it can be calculated that 1000  $\text{ug}$  would be inhaled. About 80% of the inhaled vapor or 800  $\text{ug}$  would be absorbed. Since the occupational exposure are limited to 5 days of the week, the average daily absorbed dose

would be 572 ug. Although there appears to be a wide discrepancy between these doses, it should be remembered that industrial workers are a self-selected, healthy group who would not be expected to be as sensitive to mercury vapor as the sensitive individuals in the general population -- thus standards based upon occupational health are not applicable to the general population unless account is taken of the fact that occupational workers are made up exclusively of healthy individuals in their prime years.

The best available data suggest that methylmercury and mercury vapor have similar and probably additive effects. Therefore, the combined intake of the two should be restricted to the equivalent of 30 micrograms/day of methylmercury, and the allowable exposure to atmospheric mercury depends on the intake of mercury from other sources. Although data on the dietary intake of mercury are scarce, it is estimated that the average diet, exclusive of fish and shellfish, contains about ten micrograms of methylmercury. One pound of fish a week, contaminated up to the FDA limit of 0.5 ppm, would contain the equivalent of 30 ug of methylmercury/day. For an individual with an average intake of methylmercury (10 ug/day) however, the concentration of airborne mercury would have to exceed

1 ug/m<sup>3</sup> (assuming inhalation of 23 m<sup>3</sup> of air per day and absorption of 85% of the inhaled mercury) for an individual to absorb more than the equivalent of 30 ug of methylmercury. According to the special report of the Secretary's Pesticide Advisory Committee, The Hazards of Mercury, "All controllable sources of mercury contamination should be either eliminated or maximally reduced. . . ." "The urgency of this is emphasized by the circumstances that, although mercury in any form is hazardous, all forms of mercury have the potential to be converted to the highly toxic form of methylmercury."

MR. MEGONNELL: Has it been determined, Dr. Horton, with regard to the case at Minamata, Japan, that the mercury was discharged in methyl form, or was it converted in the waterways by microorganisms, or do we know?

MR. HORTON: I am sorry, I don't know that.

MR. MEGONNELL: I see taking the Swedish data you applied a safety factor of 10. Some people might think that is quite large. Do you want to comment on that?

DR. HORTON: We didn't apply a factor of 10. The Swedish committee did this. I think in view of the data from Minamata, that the level of mercury in the fetus

is higher than in the mother. This particularly indicates a fairly sizable safety factor. Some cases appeared in the infants where the mothers did not have a high enough level for symptoms. So that I think this is not an exaggerated factor of safety.

MR. MEGONNELL: In determining this atmospheric standard I took some consolation in that safety factor of 10 until I read that you estimated the average diet exclusive of fish and shellfish -- I don't claim to be an expert -- but from my reading fish and shellfish are probably the hazard, if there is one, in mercury taken into foodstuffs.

In port cities, for example, where there's a lot of seafood being consumed, one wonders whether the safety factor is as great as you originally thought it was.

DR. HORTON: You mean just from the food point of view?

MR. MEGONNELL: Yes. You assumed the average diet has 20 micrograms of mercury exclusive of fish and shellfish.

MR. HORTON: Yes.

MR. MEGONNELL: In certain areas, depending upon the dietary habits of particular people, it could be drastically underrated, I would think.

DR. HORTON: Provided they were eating very large quantities of fish, yes. I think we have to watch this carefully and see whether this is in fact adequate. The calculations are in part based on the Swedish eating habits where fish is used considerably more than we use. It is adequate except for the peculiar cases.

MR. MEGONNELL: I think your latter statement makes a good point. I'm sure nobody considers these proposed standards as the ultimate. We better learn a lot more.

DR. HORTON: I hope not.

MR. MEGONNELL: Thank you, Dr. Horton.

I did have a request for Dr. Eisenbud to be put on this morning, but I don't see him in the audience.

The next speaker will be Mr. Ray Gerson of the New York City Department of Air Resources. Is Mr. Gerson here?

(No response.)

We will move on to the statement of the representative of Johns-Manville Corporation. I think the lead-off speaker will be Mr. J. B. Jobe.

STATEMENT BY  
J. B. JOBE,  
EXECUTIVE VICE PRESIDENT  
JOHNS-MANVILLE CORPORATION

MR. JOBE: My name is J.B. Jobe, and I am Executive Vice President for Operations for the Johns-Manville Corporation. Johns-Manville is the largest miner of asbestos fiber in the Free World and the largest producer of asbestos-containing products in the United States.

Accompanying me here today are four men who are widely specialized in the asbestos field. They are Dr. Fred L. Pundsack, Vice President for Research and Development for Johns-Manville; Dr. George W. Wright, Director of Medical Research, St. Luke's Hospital, Cleveland, Ohio; Dr. J. Corbett McDonald, Chairman of the Department of Epidemiology and Health, McGill University, Montreal; and Mr. Edmund M. Fenner, Director of Environmental Control for Johns-Manville.

As an introduction to their testimony, I would like to very briefly outline for you the position of my company with regard to the proposed National Emission

Standards on asbestos, and then to present a general picture of the size and scope of the asbestos industry in the United States . . . the types of products produced, the number of people employed, and other factors that will help establish the relative position of the asbestos industry in the economic and social structure of this country.

The asbestos industry has recognized for many years that there are occupational health hazards associated with the excessive inhalation of asbestos dust. As a result, the industry, beginning at the Saranac Laboratories in Saranac Lake, New York, in the late 1920's, has sponsored and cooperated in a wide variety of scientific research projects designed to identify these hazards and to eliminate them wherever they may exist, not only in asbestos mines, mills and manufacturing plants, but also among fabricators and applicators of finished asbestos products. In recent years, the asbestos industry, either as individual companies or through the Quebec Asbestos Mining Association's sponsorship of the Institute of Occupational and Environmental Health in Montreal, has or is continuing to support medical research at such highly regarded institutions as McGill University in Montreal, Tulane University in Louisiana, St. Luke's

Hospital in Cleveland, the Environmental Sciences Laboratory at Mount Sinai Hospital here in New York, the Industrial Health Foundation in Pittsburgh, the University of California at Berkeley, Fairleigh Dickinson University in New Jersey, the University of Pittsburgh, the Medical College of South Carolina, and a number of others, both here and abroad.

The asbestos industry has also cooperated extensively in various investigations into asbestos-health conducted by agencies of the Federal Government, including the U.S. Public Health Service, the National Institute of Occupational Safety and Health, and the Environmental Protection Agency. In fact, much of the technical and other data that formed the background of the proposed National Emission Standards under review today was obtained with the complete cooperation and assistance of the asbestos industry.

MR. MEGONNELL: I would like to interrupt, Mr. Jobe, and publicly acknowledge that with our appreciation. I am sure Mr. <sup>Dale</sup> Bill Slaughter, who is principally responsible for pulling this together, is certainly appreciative, also.

MR. JOBE: Thank you, Mr. Megonnell.

In addition, in the industry's own research



laboratories, scientists and engineers are also engaging in work related to health, developing better handling techniques for loosely bound asbestos products and also developing and improving techniques for the measurement and control of asbestos emissions both in the workplace and in the ambient air.

For many years, in fact, since the mid-1930's, Johns-Manville and others in the asbestos industry have actively been pursuing the goal of control of asbestos emissions, utilizing the best available technology of the times. Thus we are sympathetic with the concept of controlling emissions, and have invested many millions of dollars in sophisticated and highly efficient dust control equipment and techniques to reduce worker exposure and to prevent the emission of hazardous amounts of asbestos fiber into the air that the general public breathes.

We concur with the conclusion reached in the recent National Academy of Sciences report on asbestos that at present the general public is not in danger from the minute amounts of asbestos fiber present in the ambient air. We also concur in the report's recommendation that it is prudent and feasible to establish reasonable emission standards and controls that will protect the public

and ensure that hazardous levels of asbestos will not develop in the community air in the future.

For this reason, with the exception of some minor changes that Mr. Fenner will discuss later, we support the proposed Environmental Protection Agency National Emission Standards on asbestos.

With this support firmly in mind, I would now like to sketch for you very briefly the economic aspects of the asbestos industry.

In the very first sentence of the introduction to the National Academy of Sciences report that I referred to earlier, it states that "the naturally occurring fibrous silicates classified as 'asbestos' have become almost indispensable in modern technology". This statement is indeed true, and it helps explain the substantial industry that has developed around the world over the past 100 years to mine and manufacture asbestos and asbestos-containing products. Among other uses, asbestos provides built-in protection against fire and deterioration in scores of products in daily use.

Through the years, it has saved countless lives and billions of dollars in property damage by preventing or checking the spread of fires. Asbestos-containing

products are used in schools, houses, theaters, office and other public buildings, ships, spacecraft, furnaces, boilers and fire-fighting equipment. The brakes on automobiles, trucks, buses and trains are dependable because asbestos is a vital component of brake linings. It has been estimated that some 3,000 different products in daily use around the world contain asbestos.

In the United States, the consumption of asbestos fiber over the past half dozen years has remained fairly stable at an average of approximately 750,000 tons per year, with an estimated value of \$90 million. Of this annual total, 126,000 tons valued at \$10.6 million was produced domestically, the rest being imported, primarily from Canada.

Based on Bureau of the Census manufacturing statistics for 1969, the estimated value of asbestos-containing products produced was between \$800 and \$850 million. These products were produced in approximately 250 different manufacturing facilities throughout the United States, with a work force of at least 28,000 employees, and a payroll well in excess of \$200 million.

It has been estimated that approximately 75,000-100,000 additional workers depend in some part for

their livelihood on the use of asbestos-containing products. These would include construction workers; insulation applicators; siding, roofing and tile installers; pipe layers; salesmen, distributors and dealers in asbestos products, and many others. It is impossible to calculate the total income derived by these workers from the use or sale of asbestos-containing products, but it would appear to be substantial.

If one adds in the value of services, machinery, raw materials and other commodities purchased by the asbestos manufacturing industry each year for use in the production or shipment of finished asbestos products, the total economic contribution of the industry to the nation's economy would reach beyond the two billion dollar mark, and would involve, to some degree, the livelihood of perhaps 150 to 200 thousand wage earners and their families.

As you can see, the economic contribution of the asbestos industry to the nation's economy is substantial. In addition, the many and varied life-saving uses of asbestos play an important role in our modern technological society. For these reasons, it is essential that any health hazards associated with exposure to heavy quantities of asbestos fiber be eliminated. To quote once

more from the National Academy of Sciences report:

"Asbestos is too important in our technology and economy for its essential use to be stopped."

On behalf of Johns-Manville, I would therefore like to express once again our continuing recognition of the need for the control of asbestos emissions into the ambient air, and to pledge our determination to do whatever is necessary within the limits of technical feasibility to achieve such controls.

Thank you.

MR. MEGONNELL: Thank you, Mr. Jobe. I find your statement very encouraging. You went into a little detail on the sophisticated and highly efficient dust control equipment and techniques that Johns-Manville has installed. I realize you can't speak for any other company, but is it your impression that this is generally true in the asbestos industry?

MR. JOBE: I think it is generally true, Mr. Megonnell. I know a number of the other producers that have instituted similar dust controls, and to a large degree the techniques that we have developed for others in the industry, have been made available to everyone.

MR. MEGONNELL: The reason I ask, and it

is a very selfish reason, is I have to enforce these things. I am trying to find out how big my job is going to be.

(Laughter.)

You mentioned the indispensability of asbestos in brake linings. Again, I am just fishing for a little information. I always hear this as a potential problem.

I know the automobile is certainly a ubiquitous source of air pollution, but what proportion would you say of the total asbestos is used in brake linings?

MR. JOBE: I have those figures but I would roughly guess, between five and ten percent of the asbestos would be the nominal figure that is used in brake linings.

Do we have that paper there, Fred?

MR. PUNDSACK: My name is Fred Pundsack for Johns-Manville. It would be in the range of eight to ten percent in the United States.

MR. MEGONNELL: That was rather surprising to me. I think that exceeds any amount that is used for insulation (installation from figures I have seen.

MR. JOBE: Yes.

MR. MEGONNELL: Do you have any data or any opinion on the asbestos that is worn off brake linings

as an air pollutant?

MR. JOBE: I think Dr. Pundsack or Dr. Wright would be better qualified to answer that. Reports have been made and there is no indication that there is any hazard from that area. I am sure that they can enlarge upon that.

MR. MEGONNELL: Fine. I have one other questions. I think in Dr. Horton's statement he mentioned that some of the epidemiological studies were related to clothing brought home by workers and handled by other persons in the household. Does your industrial hygiene program include changes of clothing, <sup>showers</sup> (shoes) and this sort of things before workers depart from the site?

MR. JOBE: They include those as well as blow-off booths and vacuum equipment that is available to anyone who works in a high level of exposure.

MR. MEGONNELL: Do you have any questions, Mr. Baum?

MR. BAUM: No.

MR. MEGONNELL: Thank you very much, Mr. Jobe. Would you want to introduce your next speaker? I think I have them out of order.

MR. JOBE: With your permission, I would like

to ask Mr. Fenner, Director of Environmental Control, to speak.

MR. MEGONNELL: Very good.

STATEMENT BY

EDMUND M. FENNER

DIRECTOR OF ENVIRONMENTAL CONTROL

JOHNS-MANVILLE CORPORATION

MR. FENNER: My name is Edmund M. Fenner. I

am Director of Environmental Control for the Johns-Manville Corporation, and am a graduate Mechanical Engineer and a licensed Professional Engineer. I have thirty-one years

of experience in the asbestos industry with Johns-Manville. My statement this morning is concerned with

the standards themselves. In addition to nearly five years in my present position, I have been a plant engineer and a project manager in our General Engineering Department.

I agree with the comments made by Mr. J.B.

Jobe, our Executive Vice President for Operations, concerning the need for control of asbestos fiber emissions to the atmosphere. However, I believe that there are certain

sections in the proposed Standards that can be clarified by rewording, and I suggest the following changes:



Section 61.21 - Definitions

Paragraph H. This definition be changed to read:

"Particulate Matter" means any asbestos containing material, other than uncombined water, etc.

The wording "asbestos containing material," and/or "asbestos containing particulate matter" should be used throughout the Standard in place of "material" and/or "particulate matter."

Paragraph J. This statement be reworded to read:

"Visible emission" means, for the purpose of this subpart, any emission of asbestos fiber or asbestos containing particulate matter which is visually detectable.

We recommend this change in rewording because in many asbestos-using manufacturing plants there are particulate emissions to the atmosphere which may be visible that do not contain any asbestos. An example of such emission could be from other material preparation and drying operations in an asbestos-cement pipe plant.

Paragraph 61.22 - Emissions Standards for Asbestos

Paragraph (c) (1). This paragraph be rewritten to read:

"Direct forced gas streams resulting from manufacturing or fabricating operations shall have no visible emissions of asbestos containing particulate matter. If visible

emissions are present, then the gas streams shall be filtered through fabric bag filters, etc."

Our reasoning behind this recommendation for rewording is based on the fact that there are many exhaust systems utilizing forced gas streams in asbestos manufacturing operations whose purpose is the removal of other than particulate matter. A specific example is in the paper-making industry where hoods with exhaust fans are constructed over the dryer section to remove the large quantity of moisture released from the paper during the drying process. Particulate matter in these exhaust streams is virtually nil.

In addition to these few suggestions on rewording, there are two requirements in the Standards I feel need comment:

1. Section 61.09 - Source Reporting

Paragraph (a) of this section requires that the owner or operator of any existing stationary source to which this part is applicable shall file certain information with the Agency thirty days after the effective date of the Standard. I believe that it will be very difficult, if not impossible, for major asbestos-using companies, such as Johns-Manville, to register all their sources within

thirty days after the effective date. I suggest that ninety days would be a more realistic time requirement.

2. Section 61.22 - Emission Standards for Asbestos

Paragraph (b) (1) in this section states "visible emissions of particulate matter from asbestos containing tailings dumps are prohibited." Considering the present state of the art, Johns-Manville at this time does not know how to meet this requirement.

Thank you.

MR. MEGONNELL: Thank you, Mr. Fenner. I would like to try on you an alternate<sup>ive</sup> definition of particulate matter that I have been kicking around in my own mind.

Would you agree with the definition that says particulate matter is <sup>finely</sup> finally divided, solid or liquid particles, derived from asbestos-containing material?

MR. FENNER: That probably would fit the bill. I can't think at the moment of how there could be a particulate emission from an asbestos-containing material that wouldn't contain some asbestos. There might be. That would be my only reservation.

MR. MEGONNELL: I think we fully want to eliminate things such as you mentioned, sand handling and

moisture. I think the definition does exclude the moisture now. I share your concern, I am sure others do, too, for getting the definition that will be practicable, enforcable and achievable.

Could you estimate for me what particle count of asbestos could be expected if you can see an emission?

MR. FENNER: I don't have the number. As Mr. Slaughter knows, we have discussed this a number of times, we have attempted to measure the level of asbestos fiber concentrations in exhaust streams. The numbers we arrive at are very suspect. I wouldn't want to quote them as being accurate within two or three factors.

MR. MEGONNELL: I guess we all have that trouble.

MR. FENNER: Not that we haven't tried, but the numbers are not consistent.

MR. MEGONNELL: With respect to your comment, with your plea, I guess, for more time and source reporting, I am not quite sure we have that flexibility. The law envisions, in effect, immediate applicability when these regulations are adopted. We know that it is going to be impossible, and I think Congress did. We thought that

thirty days was even giving you a break. If you begin to compile the information to register these sources now, I don't think it should be such a burden, although I will grant you that there probably will be minor changes in these regulations before they are promulgated. I think that thirty days, if you have begun to compile the information, would be adequate to take care of any changes that might go into the regulations.

MR. FENNER: I might make a further comment on the subject, if I may. I think that there needs to be some clarification as to what a source actually is.

MR. MEGONNELL: I share your concern for that, too. I had nothing to do with writing the standards so I view them as an outsider. I am going to comment on it the same as you have.

As regards the matter of the tailing dumps, again, I think they want to be reasonable about it. Of course, a waiver request is in order and I will say this, from my own standpoint, in view of your company's past performance, we have every confidence that you are going to solve this problem.

MR. FENNER: We hope to, certainly.

MR. MEGONNELL: Thank you, Mr. Fenner.

I have no further questions. Do you have any questions, Mr. Baum?

MR. BAUM: No questions.

MR. MEGONNELL: The next speaker that I have listed is Mr. Fred Pundsack.

STATEMENT BY  
FRED L. PUNDSACK  
VICE PRESIDENT  
JOHNS-MANVILLE CORPORATION

MR. PUNDSACK: My name is Fred L. Pundsack, and I am vice President for Research and Development for the Johns-Manville Corporation. I have a Ph.D. degree in Chemistry, and I have been involved with research and development work on asbestos for almost twenty years.

My statement is directed to the question whether asbestos is a hazardous pollutant and whether the proposed National Economics Standards provides a satisfactory margin of safety for the general public.

The purpose of my statement is to place in perspective for these hearings the characteristics of asbestos and the manner in which the fibers occur in the United States. In addition, I will present background

data on the historical trends in the consumption of asbestos in man-made products in the United States, and the implications of these trends insofar as emission controls are concerned.

The term "asbestos" is a general term applied to a number of naturally occurring fibrous inorganic minerals. These fibrous minerals differ from each other in chemical composition and in physical structure. The proposed emission control standards which are the subject of this hearing apply specifically to six asbestos minerals: actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. From the standpoint of actual use of asbestos in manufacturing activities in the U.S.A., however, one of these, chrysotile, accounts for slightly over 90% of all the asbestos fiber used. The remainder is made up primarily of amosite and crocidolite. Since chrysotile accounts for such a large proportion of the asbestos usage, most of my statement will be concerned with the occurrence, characteristics and behavior of this variety of asbestos.

Chemically, chrysotile asbestos is a hydrated magnesium silicate, and it occurs in a rock called serpentine. Both serpentine rock and chrysotile asbestos have the same

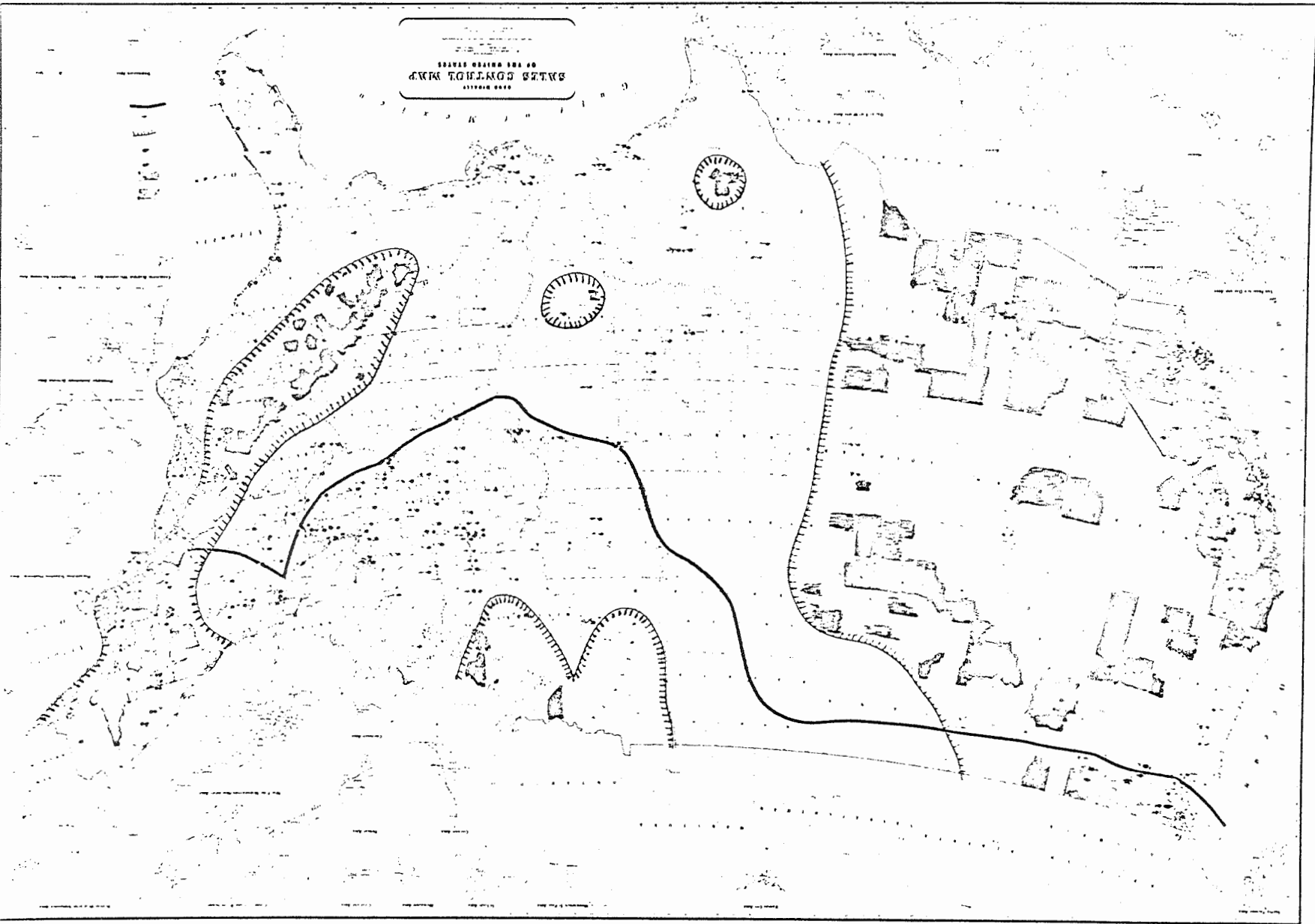
chemical composition, and in fact chrysotile asbestos is considered to be an altered physical form of serpentine. Commercial deposits of chrysotile asbestos are confined to relatively specific areas throughout the world. In the United States, commercial deposits occur primarily in Vermont, California, and Arizona. It is important to note, however, that although commercial deposits are relatively localized, serpentine, the host rock in which asbestos occurs, is a common rock occurrence throughout the world, including the United States. Furthermore, we have found that almost all serpentine rock, even that which appears visually to be barren of any asbestos fiber, does in fact contain microscopic-size asbestos disseminated throughout the rock mass.

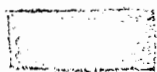
I have submitted a map to the Hearing Officer which shows the occurrence of serpentine rock.

MR. MEGONNELL: That will be reproduced in the record, sir.

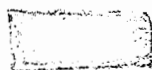
Figure 1 shows the occurrence of serpentine rock at or near the surface in the various states in the U.S. In addition, to the disturbance of this rock by blasting for road building and other construction, the natural weathering of these rock masses can be expected







- Counties in which serpentine and/or chrysotile have been reported.



- Counties in which amphibole fibers have been reported.



- Known chrysotile locations - USGS map (1962)



- Known amphibole fiber locations - USGS map (1962)



- Boundaries of areas containing rock types in which asbestos might be found.

- Cities and towns in which asbestos is used.



- Boundary of maximum glaciation.

to release a small amount of microscopic-size asbestos fiber to the ambient environment now, and to have released fiber over the past centuries too. We believe that studies now under way to determine whether or not asbestos fibers occur in centuries-old glacial and polar ice will provide important information concerning the nature and extent of a "natural" background of microscopic-size asbestos fiber which may have existed in the ambient air for thousands of years. If it is found that a "background" of asbestos fiber from natural sources has existed over the centuries, this does not, of course, alter the need to minimize and control the additions of fiber to the environment from man's activities. It does, however, indicate that probably man has evolved in an atmosphere in which some microscopic-size asbestos fibers were always present.

Regardless of whether asbestos fibers are placed in the atmosphere from man's activities or from natural sources, the fibers do not remain airborne forever. From the moment asbestos fibers become airborne, a natural process of removing the fibers from the air comes into play. The larger, heavier fiber bundles will settle out rather quickly, and only the smaller, lighter fibers will continue to be airborne for long periods of time and

conveyed by air currents over long distances. These smaller microscopic and submicroscopic fibers in turn are in the size range in which they may serve as the nuclei on which raindrops or snowflakes form, and thus they, too, in time are "washed" from the atmosphere into streams, rivers, and the oceans. Fiber which settles out of the air onto the earth's surface also is washed by rain into the waterways. In the streams and rivers, the minute amount of asbestos present, due to its surface characteristics, tends to be agglomerated with clay particles, and it settles out of the environmental transportation cycle as part of the silt and sedimentary deposits.

Thus the addition and removal of asbestos fiber from the ambient air is a dynamic process, and the amount of fiber in the general atmosphere at any moment is the result of the equilibrium between the rate at which fiber is added to the atmosphere and the rate at which it is removed. The fact that the atmosphere has the ability to "cleanse" itself of asbestos fiber does not, of course, minimize the need to control emissions to the ambient air. This cleansing action, however, does exert a significant overall controlling effect on the total amount of airborne asbestos in the atmosphere at any given time. It means

that the control of local emission sources in the manner which the Environmental Protection Agency has proposed in the emission standards under consideration should be very effective in controlling and limiting the amount of asbestos in the general atmosphere.

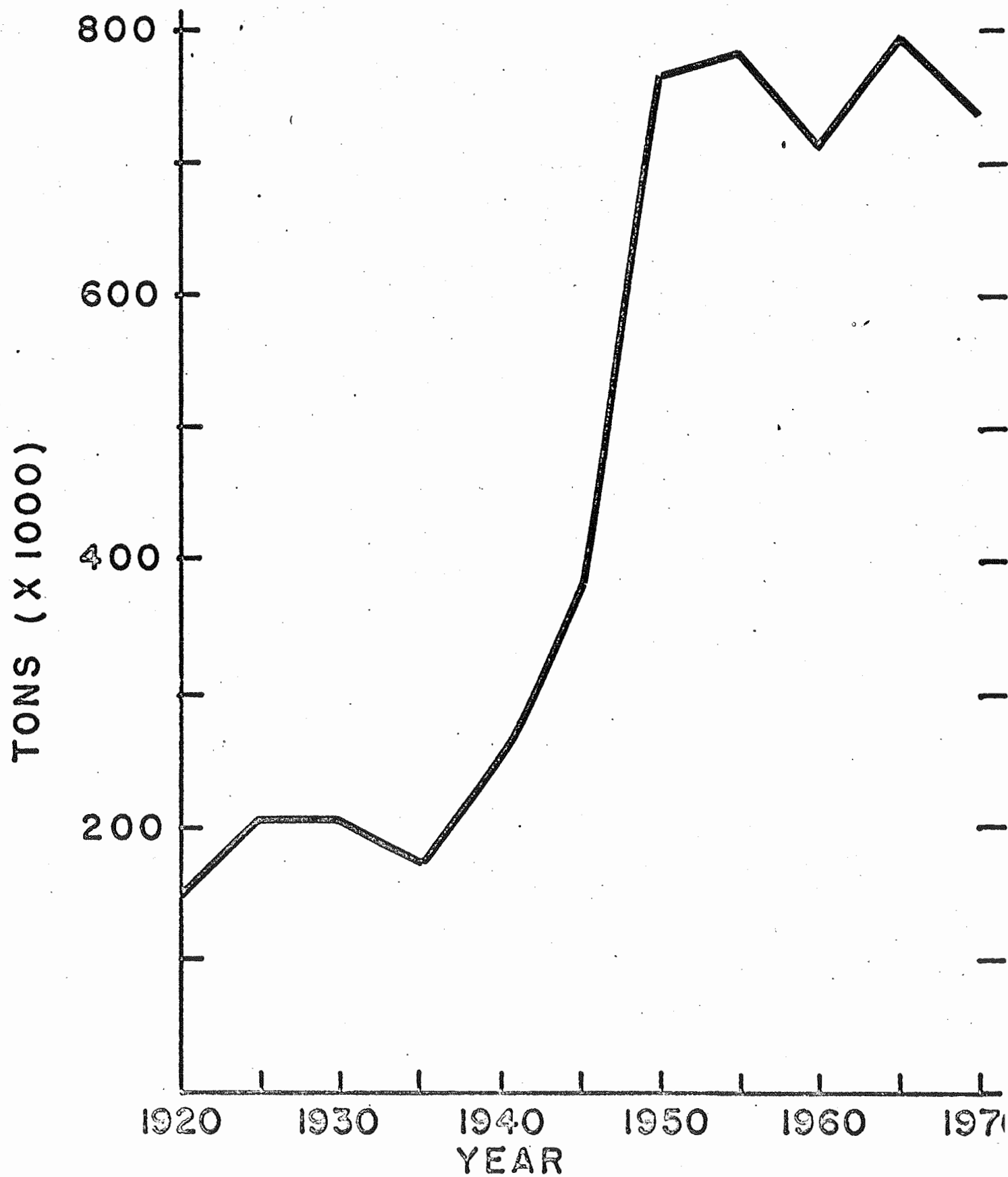
I also would like to make several points with regard to the historical trends in the utilization of asbestos in the United States, and the implications of those trends with respect to airborne asbestos.

I have submitted a graph to the Hearing Officer which shows the estimated usage.

Figure 2 shows the estimated usage in the United States of Asbestos fiber of all types from 1920 through 1970. The data show that a large increase in the usage of asbestos fiber in this country occurred after World War II, but by 1950, the usage had reached a plateau. During the past twenty years, the total usage of asbestos fiber in the United States has remained relatively constant, with the annual usage figure in the range of 750,000 tons, plus or minus 10%. More than 85% of this fiber is incorporated in products in which the fiber is "locked in" in use. Little, if any, asbestos is released from them once they have been manufactured. Examples of these

FIG. 2

## ESTIMATED U.S. ASBESTOS USAGE



products are asbestos-cement sheets and pipe, floor tile, and asphalt-saturated sheets used in roofing.

The fact that the total usage of asbestos in the U.S.A. has been nearly constant since 1950 means that the potential emissions of asbestos from manufacturing operations in the United States probably has been relatively constant for the past two decades. With the application of better emission control techniques in the past decade, actual emissions are in fact less today than they were twenty years ago. The implementation of the proposed national emission control standards for asbestos will, of course, further reduce total emissions and provide an added factor of safety for the public environment. Therefore, with the minor exceptions noted by Mr. Edmund Fenner in his statement, I support the proposed national emission control standards for asbestos.

I would like to add a comment here since the question was raised about brake linings.

Our studies and those of the United States Public Health Department indicate that the asbestos contained in brake linings is for the most part not released as asbestos fiber in the wear of the brake linings. Brake linings have a combination of asbestos and phenolic

resin with friction particles in it. In the stopping action extremely high localized temperatures are created. Measurements indicate that much less than five percent of the total asbestos present in the brake lining is actually released as asbestos. The ninety-five percent and more of the asbestos is destroyed by heat and converted into heater aid an amorphous material or into a crystalline material which is called fosterite or instatite. I think one can use these figures to get some idea of the kind of numbers we are talking about.

If we assume that there is approximately 75,000 tons of asbestos used per year in brake linings, and that essentially represents the amount that is lost in the use of brake linings, then certainly less than the total of 3,000 tons of that material is released per year in the form of actual asbestos fiber. Most of that material that is released is not released in a size which is airborne or suspendable in the air for any significant distance. I would estimate, and this is strictly an estimate, that certainly we are not dealing with anything more than 1,000 or 1,500 tons total per year over the entire United States releases air asbestos fiber which might possibly be airborne from brake linings.



MR. MEGONNELL: I thank you for answering some of my questions. I have seen the same reports. I am almost <sup>besieged</sup> beseeched by people who say, "What about the asbestos from brake linings?" I am glad you did put that in the record. I think it is a viable addition.

Just for my own curiosity, since you mentioned that asbestos is washed or <sup>rained</sup> (wringed) out, is there any hazard from asbestos in water or is it only when it is wringed <sup>breathed</sup>?

MR. PUNDSACK: So far as we know, the type of quantity that we are dealing with in the water supply presents no hazard. I think perhaps Dr. Wright or Dr. McDonald, who deal with the medical aspect of it, might wish to comment further on that.

MR. MEGONNELL: Thank you.

MR. PUNDSACK: Incidentally, we have done a great deal of monitoring of water supplies and we have found that even from soft water from deep wells, there are minute traces of asbestos fiber which we believe originate from the fact that these wells are drilled through serpentine rock.

MR. MEGONNELL: Thank you, Mr. Pundsack.

MR. PUNDSACK: Thank you.

MR. MEGONNELL: The next witness is Dr. George

Wright.

STATEMENT BY  
GEORGE W. WRIGHT  
DIRECTOR OF MEDICAL RESEARCH  
ST. LUKE'S HOSPITAL  
CLEVELAND, OHIO

MR. WRIGHT: My name is George W. Wright. Thank you, Mr. Megonnell, for the opportunity to testify at this hearing. I intend to confine my statement to the nature of the hazard posed by emissions of asbestos fiber into the air breathed by the general public and the need for control. At the outset, I wish to express my agreement with the EPA that there is a need for systematic control of asbestos emissions.

As to the qualifications from which I speak, Mr. Chairman, I should say that I am a physician graduated in Medicine from the University of Indiana in 1932. Since completion of post-graduate training in 1938, I have been engaged in research and practice of medicine, specializing in diseases of the chest. Since 1940, I have been active in the study of persons exposed to asbestos. I am the head of the Department of Medical Research in St. Luke's

Hospital, Cleveland, Ohio, affiliated with Case-Western Reserve University. Since 1965, I have been Chairman of the Scientific Committee of the Institute of Occupational and Environmental Health, Montreal, Canada, and since 1966, was Consultant for medical matters to Johns-Manville. Recently, I was one of the panel of consultants who, under the egis of the National Academy of Sciences, prepared a report on the subject of this hearing.

Most of what we now know about the biological effects of asbestos has been derived from the study of persons exposed in their occupations to the inhalation of asbestos fiber. Early in this century, it became known that some of these workers developed pulmonary fibrosis as a result of the inhalation of asbestos fibers. At the same time, the occurrence of focal areas of thickened pleura, referred to as plaques and sometimes associated with the deposition of calcium, was also noted, but not studied epidemiologically until in the last few years. An excess of occurrence of bronchogenic cancer in those evidencing pulmonary fibrosis caused by inhalation of asbestos was demonstrated in the late 1940's. In 1960 and subsequently, attention has been directed to an excess occurrence of mesothelioma of the pleura and peritoneum among some but

not all categories of asbestos exposed employees. The development of each of these manifestations in those persons occupationally exposed is characterized by a long lapse of time between the first exposure and subsequent overt evidence of the biological response. In addition, all such manifestations have been shown to be more or less dose related.

A striking and important fact disclosed in recent years is that the experience of employees exposed to the inhalation of asbestos varies markedly with the type of employment. For example, the insulation workers studied by Selikoff and others and some textile workers, such as those reported by Newhouse and others, have developed all of the biological manifestations just indicated, but with a much greater frequency than has been observed throughout the world in populations exposed only during the mining and milling of chrysotile. In fact, independently conducted research by Canadian, British, Italian, Finnish and South African scientists of those employed solely in mining and milling of chrysotile or of anthophyllite or amosite have demonstrated that workers in these exposures may have not experienced an excess of mesothelioma at all, even though they have been heavily exposed to the inhalation of these

specific kinds of asbestos fibers. Pulmonary fibrosis and an excess of bronchogenic cancer has been reported in most types of occupations, but with a substantial variation of frequency.

There is some knowledge offering an explanation of these striking variations of experience. Without going into the supporting evidence, it is clear that each of these biological reactions is related predominantly to the numbers of fibers inhaled and the proportion of them that are retained. In other words, they are dose related. Hence, those occupations with higher dose will be accompanied by more severe biological reactions.

This dose relationship is less certain for mesothelioma and pleura plaques than for the other manifestations.

The degree to which fibers are inhaled and retained is related to the shape of the fiber and the extent to which the fibers have been subdivided in processing. These phenomena in turn are related not only to the amount of energy applied to the fibers, but rather strikingly to the specific variety of fiber and even to the fibers obtained from a particular geographic location, as, for example, crocidolite which is mined in one location in contrast to another. In addition to the dose and shape

factors strongly influencing whether or not any of the biological reactions will occur, the carcinogenic reactions are also influenced by co-existing, non-asbestos agents. It has, for example, been shown by Selikoff and his associates that those insulation workers who are not cigarette smokers have no or, at most, a slight excess of bronchogenic cancer in contrast to the larger excess which occurs in those who smoke cigarettes. It is a gross oversimplification to imply that asbestos of all varieties and in all circumstances of use carries the same potential for biological stimulation.

The underlying reason for the unusually severe reaction among the insulation workers is not at all clear. I believe it is related to greater dustiness in that occupation twenty to forty years ago, and also to the use of types of asbestos fiber other than or in addition to chrysotile. It possibly is also related to such factors as smaller diameter and lack of curvature of the fiber used. Moreover, the itinerant nature of the insulation worker exposes him, far more than those in more settled occupations, to other inhalable substances in addition to asbestos, and these may influence the reactions in a crucial manner. These important factors have not been satisfactorily

delineated in characterizing the total exposure of insulation workers, especially during the crucial period twenty to forty years ago when the men now evidencing the biological reactions were first being exposed. It should be emphasized that essentially all of the serious biological reactions now being observed, especially those related to carcinogenesis, have occurred in persons exposed twenty or more years ago. During that time, occupational exposures were much greater than those of the immediate past twenty years.

Essentially all of our attention prior to 1960 was directed to occupational effects of asbestos and the development of methods for their prevention. In 1959, Wagner reported an unusual number of mesotheliomas occurring in a population living in the neighborhood of a crocidolite mine and mill in the northwest Cape province of South Africa. Some of these individuals had experienced no direct occupational exposure, but had lived in the immediate neighborhood of the mine. In this geographic area, the opportunity for substantial neighborhood exposure to asbestos existed by reason of the emission of crocidolite fibers from the plant, and also from the roads in the neighborhood which were paved with asbestos-containing

material. Subsequent studies by Newhouse and others in Great Britain demonstrated an excess of mesotheliomas in persons not employed in, but living near a plant in England which was manufacturing asbestos products from crocidolite, at times mixed with other varieties of asbestos. Exposure of persons in the immediate neighborhood of this plant twenty or forty years ago was thought to be substantial and caused by plant emissions, and possibly in addition by employees carrying asbestos home on their clothing.

Although pleura plaques have been shown to have minor or no importance to the health of those exhibiting them, they do occur but not in a systematic way in those occupationally exposed. Moreover, they have been demonstrated to occur with unusual frequency in some, but not all, populations not employed in, but living in areas where asbestos is being produced or used. Some populations evidencing pleura plaques have been observed where no production or use of asbestos is going on, but where asbestos exists in the soil and is released into the air by farming and weathering of the soil. An excess of pleura plaques has also been demonstrated in populations having no discernible exposure to asbestos.



These observations with regard to mesothelioma and to pleura plaques raised the possibility of a neighborhood or domestic hazard related to plant use and emissions of asbestos.

Evidence that persons in addition to that segment of the public living in the neighborhood of mines, mills and manufacturing plants producing and using asbestos are exposed to inhalation of asbestos developed in the 1960's. It has been known for years that asbestos fibers, some naked or uncoated, and others coated with a proteinaceous material -- the so-called asbestos or ferruginous body -- are found in the lungs of all persons occupationally exposed to respirable asbestos fibers regardless of whether or not other biological reactions to the fiber have occurred. It was a surprise when Thomson, in 1963, reported that 25% of the general public living in Capetown, South Africa, exhibited these ferruginous bodies in their lungs. Subsequent studies by others show that if the search for the very scant number of bodies or fibers present is thorough and detailed enough, virtually all of the adult general public have fibers in their lungs, though not all of them are asbestos. Those who have reported on fibers in the lungs of the general public have stressed the very scant

number of these fibers per unit of lung.

That the lungs of the general public should contain some asbestos fibers is not surprising in view of the fact that (a) asbestos-bearing rock is a rather common surface and sub-surface constituent of the earth's crust, and as a result of weathering and disturbance by road and other construction, the fibers constantly are being disseminated into the air breathed by the general public; moreover, fibers of asbestos becoming airborne within factories and other places where asbestos is being produced or used can find their way, during the process of ventilation, into the air outside these locations and thus into the air breathed by the general public; In addition, fibers of asbestos are a common natural contaminant of talc, which is used in many ways in a manner that can lead to their becoming airborne and hence inhaled by the public.

With this background of information, it is understandable that the question be raised of whether or not the general public is now at risk of experiencing the health events that have occurred in some occupational groups. While data needed to answer this important question are still somewhat incomplete, there is usable information upon

which to base judgments.

The fact that there are so few fibers in the lungs of the general public; that is, any single member, as compared to the lungs of even the lesser of the occupationally exposed workmen indicates that exposure of the general public is only a small fraction of that experienced by those occupationally exposed. Using methods now standard for measuring the dustiness of asbestos-using occupations, it has been shown that in these terms the public air at this time contains far less respirable asbestos than is present in the low category of occupational exposures. From the studies now available relating biological effects to dose in occupational populations, it appears that the low category of occupational exposure has not caused recognizable important biologic effects.

One would not anticipate the general public to show important biological reactions to the small amount of asbestos their lungs contain.

Although the health of the general public is not under systematic surveillance to the degree that satisfies all scientific criteria, there is and has been a general surveillance through the mechanism of autopsies and death certificates. From such observations, there is

no evidence that the low intensity of the general public exposure to asbestos has caused diffuse fibrosis, asbestosis or that bronchogenic cancer is thus related. Mesothelioma continues to be a rare form of tumor among the general public, even though Selikoff and his associates have demonstrated that ferruginous bodies of fibers have been present in the lungs of the general public at least as far back as 1934, and they were about as common then as now. The evidence available at this time affords little support to the belief that asbestos utilization to date has constituted a demonstrable hazard to the general public.

Exposure of the public living near sources of respirable asbestos emission or who live in houses occupied by workers who may bring substantial amounts of such fibers home comprise a sub-group of the public who must be considered apart from the others. It is in this special sub-group that mesothelioma has been demonstrated under certain circumstances to occur with unusual frequency. Those living in the neighborhoods of the mining and milling of Chrysotile, anthophyllite and amosite appear to be exceptions. Since an excess of mesothelioma does not exist under these circumstances, at this time, we do not have evidence concerning the fiber concentration in the lungs of this

sub-group for comparison to the lungs of the general public. Nor do we have adequate knowledge of the fiber count in the air of such neighborhoods. Some preliminary counts suggest it is quite low currently in the neighborhood of plants that already are making a strong effort to control emissions. It may have been substantially higher twenty to forty years ago, however.

There is no evidence to suggest, and there is some which actually controverts the concept that the public as a whole is at unusual risk with respect to lung fibrosis, bronchogenic cancer or mesothelioma by reason of airborne asbestos fibers. Nevertheless, there remains an as yet unanswered possibility that the segment of the public living in the immediate neighborhood of manufacturing plants where the emissions are not controlled or those living in the homes of those employed in such plants may be at an unusual risk of developing mesothelioma. Although there is no current evidence to afford the basis for clearly labeling airborne asbestos in the environment to which the general public is exposed as being a serious hazard to health, because of the remaining unknown relationships, and especially because of the geographical distribution of the excess of mesothelioma, it would be prudent to

control all sources of asbestos emission while additional understanding of the relationships is in the course of study. For this reason, I strongly support the proposed standards to minimize emission of asbestos fibers into the atmosphere from those places where asbestos is being produced, used in the manufacture of products, or used in construction.

Thank you.

MR. MEGONNELL: Thank you, Dr. Wright. I found that a very complete statement. Even I could understand it, which made it pretty plain. I don't have any questions.

I think that I could conclude that you think that the Administrator was correct in listing asbestos as a hazardous pollutant.

DR. WRIGHT: I do, particularly for the population that might live nearby the plants in places where emissions could occur.

MR. MEGONNELL: Thank you very much,  
Dr. Wright.

The next witness is Dr. J. C. McDonald.

STATEMENT BY

DR. J. C. McDONALD

McGILL UNIVERSITY, MONTREAL

DR. McDONALD: My name is J.C. McDonald, and I am Professor and Chairman, Department of Epidemiology and Health, McGill University, Montreal. I have been a physician for twenty-eight years, and have specialized in epidemiology and related subjects for the past twenty-four years.

I would like to interject here that I am not here as a representative or on behalf of the Johns-Manville Corporation as mentioned earlier. I accepted the invitation to be present because we have evidence in Canada, which I believe is relevant to this country's decisions and in turn relevant to our own.

MR. MEGONNELL: We are very happy to have you, Dr. McDonald. There is only one thing that caught my eye as I read through this, when you referred to the United States as being south of the border.

(Laughter.)

DR. McDONALD: There seems little doubt that all known varieties of asbestos, though chemically and physically

distinct; can cause fibrosis of the lung and pleura, or cancer of the bronchus in a proportion of workers exposed sufficiently long and heavily. The evidence of Selikoff et al suggests that the risk of bronchial cancer may be confined to cigarette smokers, but this has yet to be confirmed. This brief will examine the dose-response relationships involved in these two diseases.

More recently, an association has been demonstrated between asbestos exposure and primary malignant tumours of the pleura or peritoneum, commonly termed malignant mesotheliomas. The nature of this association is still obscure and there is no general agreement that the relationship is causal or whether all types of asbestos are equally implicated. Evidence on this subject will also be presented.

May I mention first of the research that we are doing at McGill. The findings outlined here were derived from a large on-going research program which the Department of Epidemiology and Health at McGill began under my supervision in 1965. The project has been assisted by research grants to the University from the Institute of Occupational and Environmental Health of the Quebec Asbestos Mining Association and from the U.S. Public Health Service.



We have also received substantial help and cooperation from the governments of Canada and Quebec, and from the British Medical Research Council.

Quebec offers unique opportunities for research into the effects of pure chrysotile asbestos exposure since nearly half the world's supply of this mineral is produced near Montreal and no other variety of fiber is produced in this region. With a population of about one-tenth that of the U.S.A., but similar in way of life and degree of industrialization, Canada can be much more readily studied for the occurrence of disease than its possible south of the border. For these reasons, our surveys, which are unique in nature and scope, can provide information and perspective not available in the U.S.A.

First let me outline our mining and milling surveys. Pure chrysotile has been mined and milled in the same region of southeast Quebec for nearly a century, and over this period some 30,000 persons have been employed. We recorded the detailed work histories of all known employees and established indices of exposure for each one. Until the early 1950's, there was little effective environmental control, and exposure of workers in the mills was very heavy and by no means negligible in the neighborhood.

Appropriate employee samples were drawn to study the relationship between exposure and a) clinical and functional changes in 1,200 current employees, b) radiographic changes in some 13,000 workers employed since annual radiography was begun in 1935, and c) mortality in a cohort of nearly 12,000 employees born 1891-1920.

In the mortality study, 88% of the subjects were traced, including 99% of over 4,000 persons employed ten years or more. By the end of 1969, the total number of deaths from all causes in the entire cohort was 3,270. The overall mortality was lower than that of the general population of Quebec, but in the highest dust exposure category, comprising 5% of the total, it was 20% above the rest. The excess was mainly due to respiratory disease and cancer. Altogether, there were 129 deaths from lung cancer, and 5 from mesothelioma. The death rates from lung disease and cancer were well correlated with exposure, and the excess was almost wholly in men with a dust index above 200. This level is equivalent to forty years' exposure at 5 million particles per cubic foot or about 9 fibres per ml, assuming a 5% fibre content of dust.

MR. HEGONNELL: Excuse me, Dr. McDonald.

Would such a reading give you a visible emission?

DR. McDONALD: Undoubtedly, the emission

would be visible but it would be visible by virtue of the

fact that 95% of the dust is rock dust and not fibers.

MR. MEGONNELL: I see.

DR. McDONALD: The surveys of symptoms,

pulmonary function, and chest radiographs also showed that these signs of disease were correlated with exposure, but this data has not yet been fully digested.

Now I would like to come to a survey

throughout Canada of mesothelioma. Since the end of 1967, we have established, in collaboration with the

Canadian Association of Pathologists and the Quebec

Association of Laboratory Physicians, a continuing system

of reporting of all fatal cases in Canada of malignant mesothelioma of pleura or peritoneum diagnosed at autopsy or

biopsy. In our periodic inquiries, we have made sure that

we receive a reply from every member of these two associa-

tions, which cover all pathologists in the country. Cases

and appropriately selected controls have been investigated

to find out what opportunities they had at work, in the home,

or at their place of residence for exposure to asbestos.

During the 11-year period, 1960 through 1970, 235 cases

were recorded, and material from 69% was reviewed by the Mesothelioma Panel of the Canadian Tumour Reference

Centre. This panel included a member of the U.S.

Mesothelioma Panel, and a member of the British Panel also worked with them on a sample of some 40 cases. The annual number of cases rose from 15 in 1960 to 31 in 1966, probably because of incomplete reporting in the earlier years. Since 1965, the incidence of mesothelioma in Canada has remained constant at just over one per million of population per annum, or just below one per million after correcting for the opinion of the pathology panel.

In 23% of male cases, there was a history

of definite or probable occupational exposure to asbestos compared with 5% of controls. Lesser degrees of exposure showed no excess, and very few women, cases or controls, had any occupational exposure. Probable or possible exposure to an asbestos worker in the same household was recorded

in 22 cases compared with 12 controls. On the other hand, after exclusion of occupational and domestic exposures, no case had ever resided within twenty miles of an asbestos

mine or mill, though 2 controls had done so. The nature of any definite or probable occupational or domestic exposure was of special interest. The excess was almost entirely

associated with work in asbestos products factories (11 cases) or in the application of insulation (9 cases). No control was exposed in this way. There were 7 cases directly or indirectly exposed to mining or milling compared with 2 controls. Of the 7, 5 had been employed in the industry, and 2 had lived in the same household with employees of the industry. Other occupations involving contact with asbestos or insulation materials were about equally divided between cases and controls.

The main difficulty in comparing our findings in Quebec chrysotile mine and mill workers with those of other investigators is that few of the others have attempted to estimate exposure. So far as bronchial cancer is concerned, our results are essentially similar to those of Doll and Knox et al in British textile plants, Newhouse in a British asbestos products factory, and Enterline & Kendrick in various kinds of asbestos plant in the U.S.A. Higher rates of radiographic asbestosis for similar periods of employment were reported by Selikoff et al for insulation workers, by Harries among insulation workers in a British naval dockyard, and by Murphy et al among pipe-coverers in New England shipyard. The latter study is of special interest since measurements of exposure directly

comparable to ours were made -- 44% of 101 pipe-coverers employed for an average of 17.4 years at dust concentrations of about 5 mppcf had radiologic evidence of asbestosis, which is in the same range as rates observed by Selikoff in his study and Harries in his studies. The comparable rate for Quebec chrysotile workers was 6.3%. We know that, at most, 10% of the dust in the mining and milling environment was fiber and virtually all chrysotile. The insulators, however, were exposed also to other varieties of asbestos, and possibly a higher proportion of the dust was fiber.

Only in Scotland, and to a lesser degree in Britain generally, has there been any systematic attempt to record and investigate all known cases of malignant mesothelioma. A similar incidence was observed in the United Kingdom. That is, similar to Canada, but with rather more evidence of asbestos contact in cases and controls. Our results suggest that malignant mesothelial tumors are rare, but that about a quarter of them, mainly in males, are related in some way to direct or indirect occupational exposure to asbestos, either in insulation work or asbestos products manufacture. The observations on insulation workers by Selikoff et al, and on crocidolite factory workers by Newhouse, and amosite factory workers by

Selikoff, are entirely in line with this conclusion. These two occupations are characterized by exposure, probably heavy in terms of fiber, to various types of asbestos and to other substances. In contrast, the risk of mesothelioma in Quebec chrysotile miners and millers was very low, as has also been reported from other chrysotile mining areas in the U.S.S.R., N. Italy, Cyprus, and S. Africa, and from anthrophyllite exposure in Finland.

In conclusion, it seems clear to me that, as related to asbestos, asbestosis and cancer of the bronchus may be regarded as purely occupational hazards. Though not yet completely controlled.

There seems no good reason why safe environmental standards within industry should not be achieved. In setting these, however, it is important that they take into account fiber content and variety, and that they be validated, so far as possible. By epidemiological data from similar types of operation.

The mesothelioma problem is more difficult since the exact nature of the association with asbestos is obscure. There seems every reason to apply strick environmental control in manufacturing plants and for insulation work, specially where crocidolite or amosite

are used. There is no evidence that present levels of chrysotile fiber in the general environment are related to any measurable risk of mesothelioma, and Quebec experience is reassuring on this point, but it would be prudent to identify and control the main sources of atmospheric contamination.

MR. MEGONNELL: Thank you, Dr. McDonald.

I should have asked Dr. Wright this same question. This goes back to the question I asked Dr. Horton this morning.

You and Dr. Wright, of course, are experts, specialists, I assume, in asbestos to a great extent. Is it likely that the run-of-the-mill physician would be able to tell that a chest disease in one of his patients is probably related to asbestos?

DR. McDONALD: No, I don't think there is any easy way in which he could. If he took an occupational history then that might be different, but not just by the physical nature of the disease.

MR. MEGONNELL: That is why I was a little concerned and I am sure that neither you nor Dr. Wright would say that death certificates and autopsies are by any means completely reliable indexes. They just happen



to be the data that were available, I suppose.

DR. McDONALD: Yes. I would like to emphasize, of course, that this is precisely the reason why in Canada we did not use that method but appealed to every single pathologist throughout the country.

MR. MEGONNELL: Thank you very much, Dr. McDonald.

I have two more witnesses for this morning and I would like to remind anybody who came in after I made the announcement that if you haven't expressed your desire to appear, please get in touch with Mr. Edward Reich, who will be available here throughout the hearing.

Mr. Raymond E. Gerson, Assistant Commissioner of the New York City Department of Air Resources will be heard.

MR. REICH: He left again. He will be back this afternoon.

MR. MEGONNELL: I am happy to note that Dr. Merrill Eisenbud has arrived. We will be glad to hear from him now.

STATEMENT BY

DR. MERRIL EISENBUD

NEW YORK UNIVERSITY MEDICAL CENTER

DR. EISENBUD: I apologize, Mr. Chairman. I was misinformed as to the time when I was to appear. I have prepared statements which I believe I have passed up to the chair.

I am Merrill Eisenbud, Professor of Environmental Medicine and Director of the Laboratory for Environmental Studies of the Institute of Environmental Medicine at the New York University Medical Center. I am appearing today at the request of the two beryllium producing companies, who have asked that I review and comment on the proposed emission standard for beryllium.

I have been personally concerned with the hazards of beryllium and the methods for its safe use since the fall of 1947, nearly 25 years ago, when I directed the Atomic Energy Commission investigation of numerous cases of beryllium poisoning that were then developing in the plants and laboratories associated with the Atomic Energy Commission's program. The ambient air quality standard of 0.01 microgram per cubic meter (as a 30-day average) included

in the EPA standard was recommended by my associates and me in 1948 on the basis of studies we conducted of the occurrence of berylliosis among residents in the vicinity of beryllium-producing plants. The technical information on which the proposed ambient air quality guideline was based on and was published in 1949 as an article, "Non-Occupational Berylliosis," published in the Journal of Industrial Hygiene and Toxicology.

The recommendation was made by us with great temerity. This was the first time any governmental agency had recommended a standard of air quality applicable to the general population. The recommended concentration,  $0.01 \mu\text{gm}/\text{m}^3$  was an extraordinarily low value, and since our studies were based on only several months of investigation, it was possible that additional information that we or others might subsequently develop would require a

revision of this recommended limit. At my request, the Atomic Energy Commission appointed an advisory committee to consider the evidence we had developed and our rationale for recommending that community exposure be limited to  $0.01 \mu\text{gm}/\text{m}^3$ . The committee, which included

Drs. Harriet Hardy, Philip Drinker, Robert Kehoe, James

Stern, Bernard Wolf, and Harold Hodge, were a distinguished

group of physicians and toxicologists, all of whom were familiar with beryllium disease. Our recommendation was supported by this committee, with the condition that the value of 0.01 microgram per cubic meter be regarded as a tentative figure which should be revoked at the end of one year. It was agreed that the committee would then reconvene to reconsider the matter. The reason for recommending that figure be revoked at the end of one year was to make it necessary to require positive action which would prevent our most unusual recommendation from being perpetuated without further review. The committee met annually for several years until 1956, when in the absence of any new data to justify changing the recommendation, and with little prospect that any new data would be developed in the immediate future, the committee recommended that the recommended standard be adopted officially by the AEC and that all AEC contractors be required to adhere to it.

I should add that in the interim period between 1948 and 1956 the contractors were required to abide by that tentative recommendation.

The recommendation that the ambient air concentration of beryllium be limited to 0.01 microgram per cubic meter has in the intervening years been adopted

by many state agencies and advisory groups, including the American Industrial Hygiene Association, the National Safety Council, the Toxicology Committee of the National Research Council, and several states, including New York and Pennsylvania.

The essential conclusion, after 25 years, is that no cases of beryllium poisoning have been reported in the vicinity of beryllium-using facilities that have complied with this recommendation. This air quality

criterion has thus achieved respectability not alone because it has now been in use for nearly one quarter of a century, but because it has achieved its purpose -- berylliosis as a community disease has been eliminated in this country. The Clean Air Act amendments of 1970 define the term "hazardous air pollutant" as one for which no ambient air quality standard is applicable. It would seem that since an ambient air quality standard for beryllium has in fact existed for many years, the metal beryllium is not a "hazardous material" insofar as the intent of the Clean Air Act amendments are concerned. However, I hasten to add that beryllium is potentially toxic if the existing air quality standards are disregarded.

The next point I wish to emphasize is that

cases of community beryllium poisoning were concentrated in the vicinity of two relatively large production plants, one of which is no longer in existence and the other of which is no longer a refinery. I am unaware of any evidence that a machine shop or brass foundry is a hazard to the neighboring community. It must be emphasized that these shops, which undoubtedly number in the hundreds, will in many cases handle truly miniscule amounts of this material. For example, it is not unreasonable to suppose that many of them will do no more than occasional lathing or drilling of small pieces of metal. Or, if it is a brass foundry, beryllium copper may be poured once or twice a year. Such installations should be required to take appropriate in-plant precautions to protect the health of their employees, but I am unaware of evidence that these plants have caused, or have the potential to cause, the beryllium content of the neighborhood air to rise anywhere near 0.01 microgram per cubic meter. To the contrary, ambient air measurements have been taken in the vicinity of a number of such shops and foundries and the criterion has not been exceeded. These data, together with such additional sampling as EPA may wish to conduct to confirm the validity of the existing information, should be

examined by EPA to determine whether certain categories of users could not be excluded from this proposed rule. Perhaps the rule should not be made applicable to the machine shops and foundries for at least one year, during which time the necessary data could be assembled by EPA to determine if it is necessary to apply this standard to all beryllium users. There is persuasive evidence that these small shops do not contribute a hazard to the health of the general community. Public health officials have long been alerted to the dangers of beryllium poisoning, but no cases have ever been reported in the communities near machine shops or brass foundries.

The proposed rule, as it now stands, will impose an unnecessary financial burden on the great many shops and foundries without any commensurate benefit to the public. A one-year delay to permit additional data gathering in the vicinity of the smaller beryllium users could make it possible to eliminate the need for great expense and tedious administrative procedures. Because the 0.01 microgram per cubic meter ambient air criterion has an epidemiological basis that has stood the test for 25 years, it is preferable to the emission standard. The background paper published in

December, 1971 by EPA explains that the 10 grams per day has been computed as the emission rate that provides maximum assurance that the 0.01 microgram per cubic meter will not be exceeded. The limit of 10 gms/d is specified regardless of the height of the source or characteristics of the surrounding terrain. In most situations, the emissions could exceed 10 gms/d by a very large factor without exceeding 0.01 micrograms/m<sup>3</sup> in places of habitation.

Since we are concerned here with long-term exposure, the 10 gms/d should be administered as an average emission rate, perhaps for a 30-day period.

In some places it may be a relatively simple matter to make emission measurements. This would be true if all of the airborne beryllium from within the plant is conveyed by means of a single stack to the outdoors. However, many shops and foundries have not had the need for process ventilation systems and at the present time do not discharge their plant air through single stacks. Some have multiple stacks, but many have no stacks at all, and traces of beryllium dust in amounts that are not harmful might simply drift out of the windows or otherwise be discharged through roof fans or louvers. It would in my opinion be unreasonable to expect that such shops should be required



to install process ventilation when it is not needed for protection of the worker in the plant; yet without such unnecessary ventilation terminating in a stack, the emission rate cannot be measured by any practical means. I should also note that where stacks do exist, measurement of the emission rate by the procedure described in the proposed rule could cost at least several thousand dollars per year, for which no perceivable benefit could possibly accrue.

Recognizing that 0.01 micrograms per cubic meter is the basic standard from which the 10 grams per day is derived, logic would seem to argue that the operator be given the option of using ambient air monitoring procedures in lieu of stack sampling, and I am happy to see that the proposed rules make provisions for this. However, I am concerned about the restrictive application as suggested by the language of the paragraph captioned "Beryllium" in the second column of page 23,239 of the Federal Register of December 7, 1971. While it is true that physical limitations will in some instances make stack sampling preferable to ambient air sampling, the latter should be the option of choice in most cases.

The ambient air content of beryllium in

the vicinity of a relatively small facility can, in my opinion, be adequately monitored by placing a single sampler at a critical location, preferably in the direction of maximum wind frequency, and at a distance from the source and elevation above ground that could be decided based on local conditions. In short, the air sampler should be placed at the most unfavorable location from the point of view of public exposure. This will at least indicate if beryllium is present in the ambient air in significant amounts and if further measurements are warranted.

My comments thus far have been concerned with some of the broader issues posed by the proposed rule. There are a number of details which I think are also worthy of mentioning.

I see no reason to limit the method of analysis to the atomic absorption spectrophotometer. Some laboratories presently use fluorometric or spectrographic procedures which are quite satisfactory. It is possible that other acceptable methods will be developed in the future. The important requirement is that there be provision for quality control over the analyses performed by all laboratories, and EPA should make provision for periodic determinations of the quality of the analytical

program.

Paragraph #61.02g defines modification in such a way that difficulties can be expected to arise. I would suggest changing the definition to "...any physical change in or change in the operation of a stationary source which significantly increases the amount of any hazardous air pollutant..." and I have added the word significantly. The operator should have the power to make this determination subject to audit by EPA.

Paragraph #61.05a is too strict in my opinion. It says in effect that no person shall construct or modify any stationary source subject to obtaining written approval in advance from the Administrator. In most cases the operator should be able to make such a determination on his own, again, subject to subsequent verification by the EPA.

I remind you, Mr. Chairman, I am talking now about the very small machine shop or foundry.

Paragraph #61.07 involves a very detailed procedure for obtaining permission from the Administrator to construct or modify a source. In my opinion this will prove to be totally unnecessary for most machine shops, particularly those machining beryllium copper. As I

indicated earlier, I think there should be a delay of at least one year until adequate field data are obtained which will permit a rational determination to be made as to the types of facilities that should be made subject to the proposed rule.

In Paragraph #61.34d it is specified that all beryllium samples shall be analyzed and the emissions calculated within five working days after collection of samples. It must be recognized that most operators will find it necessary to use consultants to collect and analyze the samples and it is unrealistic to believe that the results could be reported in less than five days. Moreover, there is no urgency that would justify such a requirement. The purpose of the standard would be achieved if the results were made available within 30 days.

In Paragraph #61.37b it is specified that filters should be changed at least every four days and analyzed within 24 hours after collection. As I noted earlier, this is an unrealistic requirement. I thought it impractical to expect that the stack samples could be reported within five days, and it is even more unrealistic to think we could have the results of filter paper analysis within 24 hours.

Moreover, I see no reason to specify that the filters should be changed every four days. We are concerned here with the possible effects of exposure over a very long period of time, and for administrative purposes the results have heretofore been reported "every 30 days." Some people change samplers every week, but there is no reason in principle why the samplers could not be changed monthly provided the accumulated dust load does not interfere with its operation. Incidentally, I should note here that the ambient air monitoring programs have generally specified that the 0.01 microgram per cubic meter should be administered over a 30-day period. I think that this should be changed so as to allow the operator to administer the MPC over a period of one calendar month.

Paragraph #61.37e specifies that the Administrator should be notified when a test result of any sample indicates a concentration greater than 0.03 micrograms per cubic meter, or if any average 30-day concentration exceeds 0.01 micrograms per cubic meter. This procedure will present problems due to the fact that occasional results may be spuriously reported above the indicated levels. This can be the result of contamination either of field samples or in the laboratory, and in some

localities might result from sudden high concentration of coal dust in the vicinity.

AEC procedures in this regard have been in effect for many years, and have proved workable, with no evidence of adverse health effects. In the absence of any new information to indicate that the procedures should be changed, I recommend that the AEC method of administering the air quality criterion be adopted by EPA.

I should like also to address myself to the specifications of Method 3 for determination of beryllium from stationary sources. As I noted earlier, I see no reason why the analytical procedure need be limited to the atomic absorption procedure. In addition, it is my opinion that the sampling train is excessively complicated and not practical for field use except under very exceptional circumstances. Most of the stationary sources of beryllium will be machine shops and beryllium copper foundries. I know of no evidence that effluents from such sources cannot be adequately sampled if the stack gas aliquot is filtered on a millipore filter or equivalent. Thus the impingers and ice baths are unnecessary additions which will simply complicate the sampling procedure, make it more expensive, increase the opportunity for contamination of the

samples, and in general detract from the effectiveness of the simple sampling system in which one simply draws the gas through filter media. Moreover, I see no need to measure stack temperature or moisture for samples collected from machine shop or foundry exhausts.

The gas meter should not be required since orifice flow measuring techniques are quite reliable and are actually preferable for field use.

A calibrated orifice placed upstream from the pump provides the best assurance that the flow is being properly measured. It is impractical to specify an "air tight pump" as shown in Figure 1-1 of the proposed rule.

Paragraph #3.1.1 specifies that the millipore filter or equivalent must be pre-weighed. I don't understand why this must be done, since the beryllium will be determined chemically and the weight of non-beryllium materials on the filter is irrelevant.

As regards the numbers of samples which must be required in order to adequately traverse a duct, I suggest that a set of representative samples collected at the centerline of the duct be permitted provided the sampling point is well located with respect to sources

of turbulence such as blowers, pipe bends, etc.

This, Mr. Chairman, closes my formal statement. I shall be happy to answer any questions.

MR. MEGONNELL: You gave us a lot of food for thought here.

DR. EISENBUD: The gestation period was about twenty-seven years.

(Laughter.)

MR. MEGONNELL: You wrapped it up very succinctly. I would like you to comment, though, Dr. Eisenbud, on the Administrator's decision to call beryllium a hazardous pollutant. He didn't entirely have free choice in this. I think that you will remember from the legislative history Congress very clearly said they expect the first list would include at least asbestos, beryllium, mercury and cadmium. We didn't come out with cadmium, but the fact that a pollutant has been classified as hazardous does not mean, at least, as I interpret the law, that people are now being hurt only that such harm is possible within the definition given in the Act. At least I think you will agree that beryllium can cause or contribute to increased mortality, serious irreversible illness or incapacitating reversible illness. The Administrator thought with those guidelines



that it was definitely a hazardous pollutant and it should be controlled under Section 112.

DR. EISENBUD: My comment in this respect

was simply based on what I understood to be the language to the Clean Air Act, which defines a hazardous material as one for which no ambient air quality standard has been set. I couldn't help but point out that there has been one in existence here for twenty-five years.

MR. MCGONNELL: I appreciate what you are saying, Dr. Eisenbud. We interpret that to mean the air quality criteria established by EPA.

(Laughter.)

One other point, without going into specifics on the sampling, I just have to bow to your superior intelligence. That this determination on what is a modification getting pre-advance approval, that again is specified in the law. We just don't have much option on that. I think we tried to make it as flexible as possible but the pre-construction approval is specified in the law. I imagine, people who are involved with the sampling analysts will certainly study your paper. In fact, they have said that their procedures are subject to

a lot of additional scrutiny, and I don't think anyone of them would say it is the last word.

DR. EISENBUD: I would like to have a moment to define what my concept of modifications would be in most cases. I have no question in my mind that the proposed procedure is quite applicable and desirable for major modifications, let us say, in the refinery, but as the language now stands a machine shop that adds, let us say, a drill press that may be used for beryllium is making a modification which the Administrator would have to consider. I do not think it is in the public interest that this be done. You will open a Pandora's box. It is going to need a tremendous amount of paper work.

If the Administrator doesn't have the power to make the determination that certain categories of beryllium uses can be excluded from this, then I would certainly urge that he obtain this authority, whether it require legislation or some other method.

MR. MEGONNELL: I happen to personally share your opinion on that. Before you came here this morning I made it known that I intend to comment on these standards, the same as anybody else has a right to, because I have to enforce them. I am looking for any practical way

to cut down the work load. I think it is somewhat irrev-  
lant what modifications are made, again speaking personally,  
because there is an emission standard that must be met.  
That is the important thing.

MR. BAUM: I just wanted to ask a couple

of questions.

When Mr. Megonnell was talking to you about

your views on whether or not beryllium is in fact a hazardous  
pollutant, I noticed that you were nodding, which doesn't

show up in the record. I just wanted to verify that you

agreed that except for the part of the definition that says,  
"for which there is no ambient air quality standard," you

agree that beryllium falls into the category of a hazardous

air pollutant.

DR. EISENBUD: Yes, Mr. Baum, and I may

remind the record, if I may be permitted to do so, that

my technical comment, technical in the legal sense, about

the definition of pollutant, was followed by the statement,

"However, I hasten to add that beryllium is potentially

toxic if the existing air quality standards are disregarded."

MR. BAUM: I was curious about that. This

is a standard endorsed, speaking loosely, by the AEC by

writing it into the requirements in the contracts. People

who contract with them are required to comply with this emission standard; is that correct?

DR. EISENBUD: Only in part. Historically, this problem of beryllium poisoning developed at a time when one of the main uses for beryllium was in fluorescent lamps. Incidentally, in 1947, I believe, with the finding of a substitute material for beryllium in fluorescent lamps, the AEC's requirement for beryllium increased and the AEC found itself a major customer of the beryllium industry. It made the administrative decision, since it was the major customer, that it had the moral if not the legal responsibility, to see to it that the products it was buying was manufactured safely. So the standard was set at that time as a result of investigations which the AEC sponsored, and the standards were incorporated into contracts at that time.

What the situation is at the present time with respect to the AEC I don't know because I really don't know how much beryllium the AEC is buying or what percentage it is of the total market. But I do know that the uses of beryllium have expanded considerably. It is widely used by many people other than the AEC. The authority for the .01 microgram per cubic meter at the present time presently rests either in the states which have incorporated

in the code or the American Industrial Hygiene Association, or simply the desire on the part of the beryllium industry to see to it that they avoid any beryllium disease.

MR. BAUM: I think that answers my question. Essentially then, it is fair to say, I take it, that you agree that beryllium is a hazardous air pollutant. You question whether or not there is a need for the standard or there is a legal ability to promulgate a standard because of the fact that an ambient air quality standard exists.

<sup>DR. EISENBUD</sup>  
(MR. MEGONNELL: It is a potentially hazardous air pollutant which, as far as the community is concerned, has been under effective control since about 1950.

MR. BAUM: You agree with the .01 figure?

DR. EISENBUD: Yes.

MR. BAUM: Thank you.

MR. MEGONNELL: At one point you added the word "significantly." That always bothers me but the lawyers love it because nobody can define it. I think maybe that is why it wasn't put in in the first place. Anyhow, I think we can consider making certain of these changes.

DR. EISENBUD: I would like to see the government regulations define "significantly." I would

tell you how I would define it. I would say a significant change in the process is one that has reasonable probability.

(Laughter.)

Reasonable probability of causing the emission standard to be exceeded. You define reasonable probability as what would be regarded as reasonable by a prudent person schooled in industrial hygiene principals, which is what we have to get back to.

MR. MEGONNELL: Do you have a law degree, too?

(Laughter.)

DR. EISENBUD: No, but the lawyers are practicing my profession, so why shouldn't I practice theirs.

(Laughter.)

MR. BAUM: I don't object.

MR. MEGONNELL: I think our people have realized that you have picked out a couple EPA goofs in the proposed standards. A good one is that pre-weight of the millipour<sup>one</sup> filter doesn't enter into the analysis at all.

Don't you feel it necessary that in conducting particulates to go to isokinetic sampling?

DR. EISENBUD: Yes, sir, I approve of it.

It is particularly important if you are approaching the emission standard. I didn't make any recommendation that we don't sample isokinetically.

MR. MEGONNELL: I seemed to infer that, I guess.

DR. EISENBUD: No. It is my personal experience that ten or twenty percent deviation from isokinetic samplings is not "significant."

MR. MEGONNELL: We do have some evidence in the sampling we have done that beryllium does go through the filter and it is caught in the impingers. I don't know how significant it is, but again it is a variation from what you are suggesting. I think if you would like somebody from the EPA staff might present some data on this if they have it with them.

Does anybody have such data?

MR. SLAUGHTER: Right here.

MR. MEGONNELL: Would you care to present it, Mr. Slaughter?

MR. SLAUGHTER: Do you want me to read it into the record?

MR. MEGONNELL: Is it a table?

MR. SLAUGHTER: This is preliminary results

on machine shops sampling.

The first test, for example, shows that

in the portion of the probe we caught 4.06 <sup>5.3</sup> micrograms

of beryllium. In the filter we caught .5 to be micrograms

of beryllium and then we had five impingers behind that,

and we caught ranging from .3 to 1.23 micrograms of beryllium

in the impingers.

MR. MCGONNELL: Did I hear this correctly,

.3 to 1.25 --

MR. SLAUGHTER: Yes.

MR. MCGONNELL: You caught .53 on the filter?

DR. EISENBUD: Micrograms?

MR. SLAUGHTER: Yes. We actually caught

over twice as much in one of the impinger bottles as we

did on the filter.

DR. EISENBUD: I don't know if you want

to burden the record with a lot of detailed discussion

of this. It has been my experience that dealing with

some of the best analytical laboratories in the country

in the beryllium field that one should try to collect

in the sample something more than a microgram to give

the analyst a reasonable chance to come up with a sample

result that can be well replicated. Again, as you say,



they are tentative data and I haven't seen them. This would have tremendous implications for all types of air sampling because the millipore<sup>ore</sup> filter has been regarded as essentially a total filter for airborne particulates even down into the sub-micron sizes.

MR. SLAUGHTER: The particular data I quoted were not tentative. The only thing that bothered me was that only one of the two tests that had the filter in front of the impinger bottles was completed. We have had some others with filters after the impinger bottles. We have those data.

DR. EISENBUD: There is enormous literature on the performance of millipore<sup>re</sup> and fiberglass filters, which I am sure you are aware of. The data and experience would not support the assumption that anything could get through unless it is in a volatile form. I don't know any reason to believe that beryllium exists in volatile form in this case. I think this needs to be looked at, and I am sure it will be.

MR. MEGONNELL: I think you certainly did a good job of pointing up some of the possible problems. I wouldn't be surprised if someone in our staff would want to talk to you in greater detail about it, and

other people also.

I want to thank you very much, Dr. Eisenbud.

Is there a representative here from the

Massachusetts State Department of Public Health?

(No response.)

At this time we will take a luncheon recess

until 2:00 o'clock.

(Thereupon, at 11:50 o'clock A.M., a

luncheon recess was taken.)

\* \* \*

AFTERNOON SESSION2:00 P.M.

MR. MEGONNELL: The meeting will please

reconvene.

At this time we will hear from Dr. Leonard Goldwater, from Duke University Medical Center. I believe Dr. Goldwater is appearing for the Chlorine Institute.

You may proceed.

## STATEMENT BY

DR. LEONARD J. GOLDWATER

PROFESSOR OF COMMUNITY HEALTH SCIENCES

DUKE UNIVERSITY

DR. GOLDWATER: I am presently on the faculty at Duke University in Durham, North Carolina, and also the University of North Carolina, at Campbell Hill. I am serving or have served as consultant to a number of groups, that includes industries and governmental agencies, but today I am speaking as an individual and I am not representing any particular organization.

By way of qualifications, I first became

interested in studying the effects of mercury on exposed

humans in 1936, at which time I conducted an extensive study in the hat industry, which was still using mercury compounds. During my service with the United States Navy during World War II I had a number of mercury problems presented, and from time to time over the years this has been the case. However, in 1956 I instituted a Columbia University Faculty of Medicine a research program dealing with human exposures to various mercury compounds. As a result of that program, which is still continuing, I was responsible for probably thirty research publications in various scientific journals. I have recently completed a book on mercury which is due for publication this June, if I can be excused a commercial at this time.

MR. MEGONNELL: We will all go out and buy a copy, Dr. Goldwater.

DR. GOLDWATER: I am sorry it isn't here now but I am sure we would have had a big sale.

I have had occasion to review the proposed emission standards for mercury. I have prepared formal comments on this which I can read and perhaps add to the various sections a few comments which may be relevant to the major points.

No reasonable person could take exception

to the objectives of the proposed standard nor of many similar standards now being considered. Irresponsible use of the earth's atmosphere and waters for the disposal of chemical wastes constitutes an indefensible threat to man's health and general well-being.

I might inject at this point that if I were not here today I would have been in South Carolina testifying in opposition to a proposal by a large industry to dump quite large amounts of various chemical wastes into the ocean.

These, and other simple, basic premises support the need for regulatory standards. Furthermore, standards must be able to survive scientific and legal scrutiny. A successful attack on any environmental standard would weaken the entire concept of environmental standards. This idea has recently been expressed most admirably by Dr. Herbert E. Stokinger, a veteran environmental toxicologist, presently chief of the Laboratory of Toxicology and Pathology in the National Institute of Occupational Safety and Health, U.S. Department of Health, Education and Welfare. (Science 174:662-665, Nov. 12, 1971). Among other things, Dr. Stokinger urges that "Standards must be based on scientific facts..." and that "All standards, guides, limits, and so on, as well as the criteria on

which they are based, must be completely documented." It is my opinion that the proposed emission standard for mercury does not meet these criteria. In support of my opinion, I should like to submit several general and specific comments.

#### 1. Analytical Methods

A basic requirement of any standard for

chemicals in the environment is an analytical method which can consistently, and with variations of perhaps not more than ten percent, yield reproducible results in any given laboratory and between laboratories. I am not convinced that such a method exists for application to mercury in the range of  $1 \text{ ug/m}^3$  or less. In support of my misgivings, I should like to cite two reports emanating from U.S. Government laboratories.

There are many more that I could cite but these should make the point.

The first is a paper by Wayne A. Willford, Great Lakes Fishery Laboratory, U.S. Bureau of Sport

Fisheries and Wildlife, published by the Water Resources Research Institute of North Carolina State University in the Proceedings of the Workshop on Toxic Metals in Water held on August 17, 1971 in Raleigh, North Carolina.

"Being primarily an analytical chemist, I can tell you this: I am very uncomfortable in the business of mercury analysis right now. The procedures that we have to work with on a mass-monitoring basis are not to my liking. They are generally equipped in terms of looking for a yes or no answer: Do we have a problem and approximately how severe is it? But in terms of my interest relative to establishing trends of change in the Great Lakes, analysis poses a real problem. Our precision within the laboratory runs in the area of plus or minus 20 percent. On round-robin samples, you talk in terms of 100, 200, or 300 percent differences between various laboratories. It alarms me, and I don't know what the answer is except to say that it's going to take a good deal more work. One round-robin test I know of, involving twenty laboratories, came up with results that ranged from 0.01 to 7.0 ppm on the same sample. This is an extreme example which does not represent the normal situation. But I think it is still safe to say that, analytically speaking, we have a ways to go."

This is the end of a quote from Mr. Willford's paper. Then another quote in which he says, and I quote again:

"The other thing which I think needs a lot

more work concerns our ability to work with the various organic forms of mercury. The only thing that we have been able to work with much so far is analysis of methylmercury, and depending on the day of the week, the stage of the moon and a few other things, we get recoveries of anywhere from one percent to 99 percent. I think we are close to correcting this situation, but it is obvious there are problems here, too. I think this is the area where emphasis is really needed. We have to do more in terms of coming up with good, sound, reproducible, and accurate methods for the various organics. There's a lot more in the environment to look at than methylmercury.

Differentiation of the inorganic mercury from the various organic forms is the key to many of the present toxicity questions. This is where everybody, I think, has been falling behind because the only method we have to work with which is anywhere near reasonable is for methyl, and the methods for other organic forms seem to be lacking. The one man I know of who's been working with dimethyl and ethylmercury is having real trouble proving a point because his methods are such that no one can reproduce his results. So again, I want to caution you

on analytical methodology. Don't take everything you read



at face value. You may get the impression that there is no problem, but there is."

I might say at this point that last Friday I called Mr. Willford to see whether there had been any more recent progress, and he told me that his laboratory at least now can get fairly reproducible results for total mercury, but the methods are applicable to the organic methyl forms, and he says there has been no breakthroughs as far as he is aware.

The second report, published in the Journal of the AOAC 54(1):202-205, 1971, is a collaborative study organized by R.K. Munns and D.C. Holland, Food and Drug Administration, showing that nine laboratories using an atomic absorption method which they recommend obtained recoveries of 0.00-0.06 ppm of mercury when no mercury had been added; 0.22-0.46 ppm of mercury when 0.50 ppm of  $\text{HgCl}_2$  had been added; and 0.17-0.67 ppm of  $\text{CH}_3\text{Hg}^+$  when 0.50 ppm of  $\text{CH}_3\text{HgCl}$  had been added.

In other words, the government laboratories themselves obviously are having great difficulty in getting reproducible results.

In the hands of a number of chemists with whom I have spoken, the reliability of results in analyses for

methyl mercury compounds is even less than that for total mercury. This is true for several Japanese as well as American laboratories. Gas chromatographic techniques, as presently applied, do not appear to be satisfactory. I have spoken to chemists in a number of laboratories, one as recently as yesterday in Columbia University, who finds, as is also being found in many other laboratories, that using the gas chromatographic technique there are peaks in the chromatograms which come out at exactly the same retention time as methylmercury where it is impossible for any methylmercury to have been present in the thing being tested. This has been found in a couple of laboratories in this country and in Japan. I don't know about Swedish results because they like to think that their method is infallible. My Japanese colleagues tell me that the Swedes are the only ones who think that their methods are infallible.

MR. MCGONNELL: We don't want to start any international incidents here.

DR. GOLDWATER: As an analogy to this situation, the same thing has been found with D.D.T. Some of you may have read recently that samples of earth collected 50 years ago and sealed had been opened now

analyzed for D.D.T. with positive results. This obviously is impossible and shows, of course, in another situation the lack of infallibility or the fallibility of some of these analytical methods. I just mention this to show that mercury is not unique in offering analytical problems. As far as the methylation of mercury is

concerned, Dr. Horton mentioned this this morning as one of the main bases for concern. I share this concern but I am less relaxed about accepting some of the published

data.

## 2. Methylation of Mercury

It has been widely assumed that all or

practically all mercury in any form which finds its way into bodies of water can be (or will be) methylated and that these biologically methylated forms of mercury

constitute a serious threat to health. There is little doubt that methyl mercury compounds in general are highly toxic and there is some evidence that methylation may

occur in nature.

I might say that I was a member of the

committee which reviewed the proposed revocation of

registration for methylmercury pesticides after the

New Mexico episode a couple of years ago and joined with

my colleagues in strongly urging that all methylmercury pesticides be banned. In fact, they should have been banned twenty years ago because the hazards were well recognized for at least that period of time. This is quite different from saying that because people in Minamata and Negata were poisoned that, therefore, all mercury finding its way into the water becomes methylmercury. I am distressed sometimes in finding juxtapositions which suggest that because people in Minamata were poisoned by methylmercury that, therefore, all mercury becomes methylmercury and is a threat to health. This is a big jump which I'm not prepared to take. As a matter of fact, it is a serious question as to the extent to which methylation does take place in nature -- the Japanese observers originally thought that there had been a biological conversion of inorganic mercury into a methylmercury compound in Minamata Bay. This received quite wide publicity. However, not such wide publicity has been given to the fact that they no longer believe this. In fact, they retracted this belief at least five years ago. They no longer believe that biological methylation was a factor at all in Minamata disease, but, on the other hand, the factory which was involved in this situation

was actually dumping chemical methylmercury compounds into Minamata Bay.

This was also true in the Negata situation where as a result of an earthquake or some similar disturbance, a large amount of methylmercury found its way into the river and into the fish eaten by people in that area. In other words, in those two situations there was clear-cut direct pollution by methylmercury itself in the chemical form. There is no need to call on a biological methylation in nature to explain what had happened.

I have recently (Oct.-Nov., 1971) spent three weeks in Japan during which time I visited Minamata and also conferred with a number of prominent Japanese scientists who have studied the Minamata disease. These scientists do not believe that biological methylation had anything to do with this disease and also emphasized their difficulties that they are having with their analytical procedures.

In a study now in progress at the University of Wisconsin, more than 300 strains of bacteria, including some from Minamata Bay, have been tested for their ability to cause methylation of various organic and inorganic mercury compounds.

The laboratory there has not been able to produce the bioconversion even though they have tried to duplicate the conditions which will be most conducive to cause the reaction to go. What this means is that theoretically methylation can take place but actually, if it does, it probably is a rarity rather than a general thing. Therefore, I think it is exaggerated to assume that all mercury getting into air or anything else eventually is going to end up as methylmercury.

### 3. Mercury in Food Chains

Much of the apprehension about mercury in the atmosphere as well as in other parts of the environment has centered around its accumulation, particularly in a methylated form, in food chains. That that analysis can be trusted. In addition to the points mentioned above, there are several relevant pieces of information. In the United States and in Sweden, it has been generally accepted that all or practically all mercury in fish (and perhaps in other foods) is in a methylated form. Several Japanese laboratories have been studying this subject with great intensity and have found that even in fish the average concentration of methylated mercury represents about one-half of total mercury.

There is obviously a great difference of opinion between the Japanese and Swedish observers. As far as I can gather, in this country there are very few people who are doing methylmercury analysis or trying to analyze for it. They are taking fish and analyzing them for total mercury and assuming that all the mercury in the fish is methylmercury, or that 98 or 99 percent is methylmercury. I don't understand why one is more ready to accept the Swedish data than the Japanese data in this respect, but this is what has been done in this country.

Evidence that at least some mercury compounds are detoxified as they enter or pass through foods chains has been adduced at the University of Wisconsin. It has been shown, for example, that phenylmercuric acetate and methylmercury chloride, after reacting with algae have lost their toxicity for other algae.

Incidentally, this work is in progress and feeding these analogies to animals to see whether they are in fact detoxified for higher living species is now underway. There should be some data available on this within a few months.

A reasonable explanation for this would be that the mercurials are bound to protein molecules in a

way which alters their chemical or toxicological activity. This also is compatible with the known fact that mercury in some form is present in all foods and probably always has been and except under extreme conditions such as at Minamata, Alamogordo, etc. is completely innocuous and may even be an essential micronutrient.

This idea is substantiated in one of the documents to which reference has been made, the so-called "hazards of mercury" in which the point is made that the traditional food chain build-up may not occur with mercury. This is also questioned, where the mercury will build up in food chains.

Closely related to the binding and detoxification of mercury in living organisms is that which occurs in soil and in silt. It is not true that mercury compounds always pass freely through soil into water or into the atmosphere. Practically all soil, especially in the upper layers, contain rich supplies of humates which tightly bind mercury. Similar compounds (fulvates) are found in the bottom silt of streams and lakes. They may be looked upon as nature's purifiers. The extent to which the humates and fulvates actually detoxify mercury has not been extensively studied. But their binding capacity has been



studied and is well known.

#### 4. Inhalation of Mercury

Much of the available information on the

effects of inhaling mercury vapor or aerosols comes from studies of occupational exposures. For many years there have been industrial hygiene standards, now known as

threshold limit values or TLV. Recently the TLV for mercury vapor was reduced from  $0.1 \text{ mg/m}^3$  to  $0.05 \text{ mg/m}^3$ . Historically, TLV's were not intended for use in any legal codes or regulations but were designed as guides for industrial

ventilation and other industrial hygiene practices. In

the absence of any alternative, TLV's are now being incorporated into laws and codes, a use for which they were not

intended. They have even less relevance to emission standards.

An extensive study of human exposure to

mercury vapor under controlled conditions was reported

by a German physician in 1928. Over a period of fifteen

years, he subjected about 2,000 individuals to a total of

more than 100,000 inhalations, an average of 50 exposures

per person. Mercury vapor, generated by heating the metal

in a closed system, was conducted through a tube directly

into the subject's nose. By measuring the mercury vapor

concentrations in the apparatus and mercury in the urine

of the exposed person, it was calculated that the amount of mercury absorbed was from 100 to 200 milligrams per exposure (100,000 to 200,000 micrograms). None of the subjects complained of any discomfort during the treatments, but two showed a mild, transitory albuminuria, one developed inflammation of the gums and four had a slight, evanescent tremor of the hands. Most of these people remained under observation for from two to four years during which time no late complications appeared. The relative harmlessness of these high exposures is impressive and shows a huge margin of safety.

#### 5. Specific Comments on Background Information - Proposed

##### National Emission Standards

a) p. 15, para. 4. It is stated that "... most atmospheric mercury is probably chiefly elemental mercury in vapor or aerosol form." In looking at the reference I find this an inadequate quotation which says we know practically nothing about the chemical. This is an inaccurate quotation from the source cited (ref. 2) which says, among other things, that "... we know practically nothing about the chemical and physical forms of mercury in the atmosphere or of their transformations therein."

b) p. 15, para. 5. While it is true that

mercury vapor affects the central nervous system, it is

also true that the harm, if any, is reversible. This is

in contrast to injury from alkyl mercurials in which the

damage is almost invariably permanent. Drastic restrictions

applicable to the latter would not have the same cogency

for the former.

Mercuric ions do not necessarily result in

damage. It has been shown that the therapeutic effect of

mercurial diuretics is due to mercuric ion. This is a

curative effect and not a damaging effect. Therapeutic

effect may be the opposite of damage.

c) p. 16, para. 2. In my opinion, and

for reasons mentioned above, it is arbitrary, unscientific

and unjustified to consider methylmercury in diet and

mercury vapor in air as equivalent. Their actions are

totally different, and treating them as equivalent, to

me, is not scientifically justified. It would be equally

logical (or illogical) to use mercurial diuretics, which

can be beneficial when given intravenously in milligram

and gram doses, for comparison with mercury vapor.

d) p. 17, para. 3. If, as this paragraph

states, "... there are few existing data concerning

atmospheric concentrations of mercury" and "...measurement methodology is in a state of evolution," this proposal for an emission standard must be based in large measure on assumptions and on speculation. With measurement methodology still not standardized, it is difficult for me to understand how monitoring and enforcement can be accomplished.

I hope I have not conveyed the idea that I am opposed to standards designed to control the emission into the environment of mercury or any other potentially harmful substance. Nothing could be further from the truth. In the case of mercury vapor, I do not believe that a critical situation exists or that we are faced with any "imminent hazard." In spite of deficiencies in analytical methods, I believe that it would be a simple matter to obtain a quantity of useful information in a matter of a few weeks or months.

Here I refer to getting background data in a number of situations which I think can be done. As a matter of fact, since I prepared this statement I have had come into my hands some additional background data. It is coming in every day now.

MR. MEGONNELL: Could you submit it for the record, Dr. Goldwater?

DR. GOLDWATER: I am not sure that I can. It was sent to me as a confidential communication. I will be glad to talk to your staff people about this and about other things.

MR. MEGONNELL: That would be very helpful.

DR. GOLDWATER: It should not be necessary to threaten the validity of the concept of emission standards by premature action. In the long run, I believe it would be counter-productive to follow the course that was taken for mercury in fish. A standard (called a guideline) was selected arbitrarily and then a Herculean effort was needed to justify it. To me, it seems more logical to assemble the relevant data before, rather than after a standard is set, especially when there is no state of emergency.

In further support of my position, I should like to cite the words of Dr. Charles C. Edwards, Commissioner of the Food and Drug Administration, as quoted in Hospital Tribune, December 13, 1971, criticizing "...so-called authorities (who) find themselves a cause and loudly trumpet it, often with more emotion than scientific fact to support them." Dr. Edwards further urges that, "We must see to it that this public interest is predicated upon and nourished by scientific fact and not emotionalism."

The inadequacy of information for setting

standards for mercury was mentioned by Mr. William D.

Ruckelshaus, EPA Commissioner, in testimony before a House

of Representatives Subcommittee of the Committee on

Appropriations on April 27, 1971, when he stated, "Obviously

in the case of mercury we need to have more information

than we now have." Apparently the situation had not

changed very much by December 9, 1971, when Mr. Ruckelshaus,

speaking in Chapel Hill, N. C., declared that EPA has about

thirty percent of the information required for setting

standards. My own opinion is that this estimate is overly

optimistic.

MR. MEGONNELL: Dr. Goldwater, in your

first sentence you state "no reasonable person can take

exception to the objectives of the proposed standards."

Am I to take from that that you agree with

the Administrator that mercury is a hazardous substance

within the meaning of the Clean Air Act?

DR. GOLDWATER: This is a tricky idea of

what is a hazardous substance. Dr. Eisenbud used the

term potentially hazardous. I would prefer that term

because, obviously, all mercury is not hazardous, and

all mercury in every form is not hazardous, and all mercury

in any conceivable concentration is not hazardous. Certainly, there are mercury hazards. I have seen many cases of mercury poisoning. I have seen some of the Minamata victims. My feeling about this is that those cases where poisoning has occurred represent unusual situations with high concentrations affecting a relatively small number of people in a very localized area. I do not believe that mercury vapor in the general atmosphere could be considered a hazardous material, except in these localized areas close to sources of concentrated emission.

MR. MEGONNELL: I think you can appreciate the dilemma faced by the Administrator. He has a rather broad definition. Does mercury in any form, any concentration contribute to reversible illness?

DR. GOLDWATER: Of course it does. Again, what is sensible, what is reasonable? I can say that mercury saves lives and I would be telling the truth. The concept of what is a poison is a purely quantitative one. Sodium fluoride is roach poison, but we put it in our drinking water and make everybody drink it.

MR. MEGONNELL: I have been subjected to those arguments for two decades.

DR. GOLDWATER: It is a quantitative thing.

You can't have a simple definition.

MR. MEGONNELL: All right, fine. I note

on the top of Page 2 you discuss the difficulty of making atmospheric measurements of mercury at one microgram per cubic liter or less. I think we would be forced to agree with you, but the proposed standard is not in atmospheric concentration, I am sure you appreciate that, it is an emission standard which requires no measurements of concentrations within several orders of magnitude of this

dilution you are talking about.

DR. GOLDWATER: You are talking now about a total amount that may come out of any one source in a twenty-four hour period?

MR. MEGONNELL: Yes. The one microgram

per cubic meter was the basis for calculating back to a source. We do not envision today testing the atmosphere at one microgram per cubic meter level. I think we would agree with you that it is probably beyond the threshold of detectability.

DR. GOLDWATER: You could do it but it

wouldn't be very easy.

MR. MEGONNELL: You devote some discussion

to the problem of the measuring of various organic mercury



compounds, and the standard refers, of course, to the two principal sources of emissions of elemental mercury. Clearly, the difficulties in measuring organic mercury compounds, do not bear on the question of measurement and testing in the enforcement of these standards.

DR. GOLDWATER: That is true, but they do bear on the overall environmental hazard of mercury. Dr. Horton made a great point of the importance of methylation. What I am trying to say here is we are not at all sure about this whole methylation process. Using this as a basis for evaluating an overall threat I think puts us on very, very weak ground.

MR. MEGONNELL: I understand your position, Dr. Goldwater.

You quote the Great Lakes Fishery Laboratory and the Food and Drug Administration regarding the analytical difficulties for ascertaining levels of mercury in fish. Would you agree that there is quite a difference between analyzing mercury in fish where it may be bound up in great gobs of organic matter as opposed to a sample we might take out of a stack, for example?

DR. GOLDWATER: The latter would be simpler if you are doing analyses of water. There isn't a lot of gunk there that you have to get rid of. Yes, it would be

much easier to do stack analyses.

MR. HEGONNELL: In Minamata there was, according to your references, methylmercury discharge.

DR. GOLDWATER: That is right.

MR. HEGONNELL: Where did it come from?

DR. GOLDWATER: From an acid aldehyde vinyl chloride plant located on the shores of Minamata Bay in Minamata Town.

MR. HEGONNELL: You have expressed an opinion on this. Do you feel that the data generated by the Swedish investigators are not reliable?

DR. GOLDWATER: I am always suspicious of anybody who has no doubts about his own correctness, including myself. We have an old saying: "Often in error, never in doubt." The Japanese say that the Swedes are the only ones who believe their own work. This is not true because here there are many people who choose to believe the Swedish observations for whatever reasons I don't think we have to go into now. The Japanese have been in this longer than anybody, and I am sure that they have devoted more time and effort to this than anybody and probably more than anybody else put together. I am impressed that they are quite competent chemists as well as research people. It could be just as logical if we have to accept somebody else's data;

why not take the Japanese? I think we should try to develop our own if we can.

MR. MEGONNELL: I certainly can't argue with you on that.

DR. GOLDWATER: We haven't got it in this country, at least I don't know about it.

MR. MEGONNELL: You have mentioned that there are some incidents where methylation may occur in nature, but in the tests that have been made to date, to your knowledge, this hasn't been demonstrated even under conditions which would favor the reaction.

What are such conditions that would favor methylation?

DR. GOLDWATER: It has to do with the temperature of the medium in which you are trying to produce this reaction, the amount of organic and type of organic material present, whether or not you are dealing with aerobic or an aerobic condition. The acidity of the pH of the medium, all sorts of conditions you can manipulate.

MR. MEGONNELL: Somewhat classical biologic conditions.

DR. GOLDWATER: Yes.

MR. HEGONNELL: You are familiar with the Swedish reports where it is claimed that they found mercury in remote lakes far from industrial sources. Do you have any opinion as to how the mercury got there?

DR. GOLDWATER: Yes, I do. This has been found in this country, too, and in many other places. In fact, I know that there is mercury in everything, depending on the geological formations that underlie the ground waters or through which the ground waters pass feeding the lakes or draining into the lakes. This could be an explanation of how you find mercury in these remote places. I know that some people choose to believe that it is mercury which have been wafted there through the breezes and the wind and deposited. This is a possibility, but I think it is more reasonable to me that it has just always been there. It is part of the geology, the geochemistry of the region.

MR. HEGONNELL: Is mercury fairly common in the earth's crust?

DR. GOLDWATER: It is there. I can't give you the figure offhand of its actual abundance, but it is found in more than trace amounts in thirty or forty different kinds of ores. It is in everything. There are

regions where it is in greater concentration. This is true in land masses, it is true in the oceans, too. So we can account for varying concentrations of mercury in fish, depending on where they spend most of their feeding time. It may be in a rich mercury area or a poor mercury area. There is mercury in everything, this we know.

MR. MEGONNELL: You mentioned that the Japanese have found that the average concentration of methylated mercury represents about one-half the total, and, again, the Swedish say that it is ninety percent or something like that.

DR. GOLDWATER: Ninety percent or more. There is a great difference of opinion here. The Japanese are willing to say that they are not certain of their analyses, but they also say the Swedes should be. The Swedes won't express any doubts at all about their own data.

MR. MEGONNELL: I don't quite get the tie-in that you quoted there indicating that mercury might be a micronutrient.

DR. GOLDWATER: Yes. This means that it may have an important biological function in living systems, including humans. This I postulated about five years ago

at which time I didn't take it too seriously, and most people laughed at me when I proposed this. Now, incidentally, I am proposing that <sup>lead</sup>LEM may have the same significance.

MR. MEGONNELL: Oh, no!

DR. GOLDWATER: We will come to that some other time.

(Laughter.)

I started looking for evidence. I said here is a hypothetical situation. This is how we do everything. Here is an idea. I want to see whether this is a valid idea or not. They call this a testing hypothesis.

I began looking at the literature and looking for evidence. It is a case of seek and ye shall find. If you begin looking for these things, you find them. I have now assembled quite an impressive array of references, of studies, research that has been done showing that in fact mercury does do some useful things, such as playing a role in certain detoxification processes. One difficulty is with isopropyl phosphate enzymatic silting, or detoxification of this is enhanced by mercury. As a matter of fact, I related these hypothetical things, there is a lot more to it than we want to go into now from the evolutionary point of view and a whole lot of other things of this sort.

I mentioned a study I did in 1936 in the hat industry. One of the things that I found then which I could never explain was extremely high hemoglobin values all out of sight. I thought my equipment was wrong, or I was getting mercury poisoning myself, or something. I checked out all the equipment, the re-agents, I did the controls through the same pipettes, the same solution, the same everything. I got these very high values. I never could understand that until about two years ago someone called to my attention the fact that mercury is involved in oxygen exchange in the body and certain enzymes relating to the transfer of oxygen into tissues, which process can be enhanced by mercury and the contrary of that is it is enhanced by a little bit and destroyed or inhibited by a lot. This is a usual thing; a little bit can be even good, a whole lot is bad. This then at least offered a theoretical explanation for this finding of these high hemoglobin values. In other words, the amount of mercury in these people was enough to inhibit the transfer of oxygen from the hemoglobin to the tissues. This is very much like what carbon monoxide does. It is a different mechanism but it causes the tissues containing oxygen deficiency. This then is reflected in a compensatory overproduction of

hemoglobin to take care of the deficit. At least here is an explanation. I am not saying this is so, but I think it makes sense.

MR. MEGONNELL: It is still hypothetical?

DR. GOLDWATER: That is right, but little by little bits of evidence are coming together. There is another thing which we all know. If we look at the list of trace metals, recognized as having essential functions the first one was drawn up, I think, in 1949 by Mr. Williams. He had about six metals on there. Each time a new list comes out there are two or three more on it. I am sure that this is going to continue indefinitely. Of course, we find that these things may be really needed. Now we have the analytical techniques, so we can find them where formerly we couldn't. We would just say they are not there because we couldn't test in that sensitive range. I think that theoretically and experimentally you can make out a pretty good case that mercury may be doing something useful in the body.

MR. MEGONNELL: Let us speak a little bit about TLV's. I notice that you state, and I didn't realize



this, it has recently been reduced from .1 to .05 milligrams per cubic meter, which is 50 micrograms per cubic meter.

DR. GOLDWATER: That is right.

MR. MEGONNELL: These are to protect people. They happen to be workers who work eight hours a day, forty hours a week, normally healthy individuals who presumably get some medical surveillance. This doesn't seem to me to be such an excessive safety factor. We are talking about one microgram for the aged, the infirm, extremely sensitive person not eight hours a day but twenty-four hours a day and maybe seven days a week. In view of that perspective, this perhaps is not too far out of line. Would you care to comment on that?

DR. GOLDWATER: Yes, I would be glad to. These TLV's are largely arbitrary figures and they are not, as I said, designed for anything more than a general guide to people in terms of industrial hygiene or occupational exposures. They have been verified in many cases empirically by just they work. Whether they could be a lot higher or more permissive and still work, we don't know, but at least the levels that have been proposed in the past have been effective.

MR. MEGONNELL: Why would they reduce it?

If the point one worked, why would they cut it in half?

DR. GOLDWATER: There are various reasons for this. There were some studies made which indicated that perhaps some people would develop symptoms. These are working people. That is another whole story which I don't think we can go into here, unless you want to. This study, again, was designed for another purpose which was then adopted or taken over into this. In other words, we are so hungry for data that when we have got any we tend to use it all over the place where really it wasn't intended for anything but a specific use when the study was set up.

To get back to your question about this margin of safety. We know very well that most people, and in fact, anybody who has ever been looked at, who have a very effective respiratory system, mercury, particularly the inorganic forms, when it is absorbed is excreted quite rapidly. They don't build up. There is a difference between the inorganics and the alkyls. The alkyls bind very strongly on blood vessels and in brain tissue. You don't get rid of them very quickly, but the inorganics don't bind in the same way and they are excreted very rapidly. At these levels you are not going to get any build-up. This is why I think we have got a

huge margin of safety.

Of course, we can go off on the importance

of stress. If we don't have any stress we would deteriorate.

Maybe we should build in some stress.

MR. MEGONNELL: I think there is plenty of

stress without making some more.

DR. GOLDWATER: Probably this is true.

MR. MEGONNELL: You also refer then to this

German study in 1928. Haven't then these tests been repeated

since then?

DR. GOLDWATER: No, nobody is likely to

repeat them. This was a pretty drastic procedure. This

study is not very well known.

This is one of the dividends of working on

a book, you go dig into everything. Actually, these people

were being treated for syphilis. We don't use this kind

of treatment for syphilis any more.

MR. MEGONNELL: Is mercury good for that?

DR. GOLDWATER: It was alleged to have been

good. I personally think it never cured a case of syphilis.

MR. MEGONNELL: I am not personally interested.

DR. GOLDWATER: We have got better methods

now.

(Laughter.)

They used to say that mercury miners should pay to work in the mines because they protect themselves and all that sort of thing.

MR. MEGONNELL: You say they were exposed an average of fifty exposures per person over a fifteen year period. I agree they are very massive doses.

DR. GOLDWATER: These are huge doses.

MR. MEGONNELL: That is an average of three times per year.

DR. GOLDWATER: No. The study was conducted over a period of fifteen years, but these people were exposed once or twice a week for a total of fifty exposures.

MR. MEGONNELL: That is quite a difference.

DR. GOLDWATER: They weren't spread over

that period of time. I guess that isn't very clear there. This was a fifteen year study in which the series built up to 2,000 persons being subjected.

MR. MEGONNELL: Which destroys my next

question so I won't even go into it. I was going to make the point that if it is an average of three exposures per year, and since you say it is reversible, well, it didn't seem to prove too much.

DR. GOLDWATER: I should have made that clear, that they were treated once or twice a week which was the normal treatment schedule. So they were really piling it into these people.

MR. MEGONNELL: Yes, I think under your

specific comments on the technical report the staff has reported, yes, you have picked out again a wrong reference in your first comment. They do have a reference that quotes the material they say but they listed it wrong.

DR. GOLDWATER: I see.

MR. MEGONNELL: In the matter of diuretics

which contains mercury, I suppose in my great medical expertise I should say that the mercury kind of fools the body system. Isn't there a point above which too much mercury might be harmful? I am sure this is carefully prescribed.

DR. GOLDWATER: Of course, there is a point beyond which too much of everything, including oxygen and sodium chloride, can be dangerous and lethal. In the use of the mercurial diuretics there are a number of cases in the literature where anywhere between fifty and eighty grams of mercury have been given over a period of time. That is quite a few micrograms. This has kept

people alive. No evidence of injury, of course.

I always carry around sixty million micrograms of mercury in my pocket. Did you ever see sixty million micrograms of mercury?

MR. MEGONNELL: I might have, but I didn't recognize it.

(Laughter.)

DR. GOLDWATER: I will let you hold it in your hand if you want. There is sixty million micrograms of mercury.

(Indicating.)

People get frightened by micrograms. It is not very much.

MR. MEGONNELL: With regard to the information near the end of your paper where you indicate that perhaps we should wait a reasonable period of a few months in order to get some of the data, which I think we will be honest with you we would like to have, too. I am just afraid, perhaps <sup>you</sup> we read the statute wrong, we don't have this option. The law says within ninety days you had to propose these things, within so many more days you had to do something else, and within a hundred eighty days you must promulgate them. I think we would be very, very interested

in keeping in touch with you and other knowledgeable people to get the up-to-date information, but whether we can withhold promulgating the regulations, I don't know. Maybe Mr. Baum has an opinion on it?

MR. BAUM: I have no opinion on it.

DR. GOLDWATER: Bob Horton and I have sweated out a number of things together. We happen to live in the same part of the country. I have worked with a number of people down there at EPA, and all of those agencies, as well as some in the Institute of Occupational Safety and Health and all sorts of things. They know that I love to talk about mercury. I would like to extend to them an invitation to invite me to confer with them about these things. I would be very happy to give them this new data which I am getting all the time.

I have organized a little project which keeps me in touch with some of the major work that has been going on. The reason for collecting it is to use it. Obviously, we all want to use it, and we want to see that it is put to work. This is a very rapidly changing field and new stuff is coming in all the time.

One thing that bothered me a little bit is what you selected here as your sources. I think that

there are other contributors to the environment much more threatening than chlor-aldehyde plants or reduction plants.

MR. BAUM: You mean other sources of mercury?

DR. GOLDWATER: Right.

MR. BAUM: In the same form?

DR. GOLDWATER: I will discuss this privately with your staff. I don't want anybody to think we are throwing red herrings around.

MR. MCGONNELL: I know we are fully aware

there are other sources. We are looking at them. As I

said earlier, the first go around is not the end of it.

We intend to continue research, update any needed standard

as we gather information on it. I can't speak for the

staff, but I am sure they will be in touch with you.

DR. GOLDWATER: We have a way of getting

back at them, you know. We at Duke are the family physicians

for all the employees at the EPA center down there so we

can crawl in and do spinal taps on them, or something.

(Laughter.)

They all get proctoscopies now, but that

is their own choice.

(Laughter.)

MR. MCGONNELL: I think that is irrelevant.



(Laughter.)

MR. BAUM: I'm just curious about this.

These other sources of mercury, I take it you do agree, as your first sentence indicates and as the very last paragraph in the paper indicates, that if we had enough

information you should control this to the extent possible. Essentially we don't have enough of the kind of information we need in order to do it right at this minute.

DR. GOLDWATER: That is part of what I am

saying, yes. I think there isn't any immediate threat.

I don't think we are going to have big numbers of people

getting sick, or anything, if we don't do anything in

particular now except see that people don't live downwind

from an ore reduction plant where they are distilling

mercury out of bark, and we don't have people living on

fish in a Minamata type of situation.

MR. BAUM: Do you actually mean that people

shouldn't live downwind of the plant, or do you mean the

plant should be controlled?

DR. GOLDWATER: I think some of each. It

depends on the local situations. Certainly there is enough

mercury vapor coming out of a bark roasting plant to make

people sick if they happen to live right there. Usually

they don't live near these places. Of course, sometimes the workers get sick from this. If you have got such a plant out in the middle of the desert somewhere with nobody within a hundred miles, I don't see that you have to do much about this.

MR. BAUM: I don't want to take up any more time. I really don't understand very much about this. I have the impression that mercury remains in the environment once it is put there.

DR. GOLDWATER: It cycles around. As I have mentioned, there are these binding mechanisms in the soil and in water sediments and they take it up and it sits there. You can't destroy mercury. No element can be destroyed.

MR. BAUM: If no controls are put on mercury, say no emission controls on any emissions, either on water or air, eventually the environment will be polluted by mercury.

DR. GOLDWATER: I will get after you very quickly if you didn't do something. I would be among those who would be the first to say, "Why aren't you doing anything?"

MR. BAUM: You don't want to start now with

the air?

DR. GOLDWATER: I would like to start on

a localized basis and pick out those things which are

easily recognized as distributing large amounts of mercury

into the air and work on them first, sort of on an individual

basis rather than be on a blanket basis.

MR. MEGONNELL: Thank you, Dr. Goldwater.

I think you are an excellent witness and a delightful

person.

DR. GOLDWATER: Thank you.

MR. MEGONNELL: Next we will hear from

Mr. Raymond Gerson, Assistant Commissioner of the New

York Department of Air Resources.

STATEMENT BY

RAYMOND GERSON

ASSISTANT COMMISSIONER

NEW YORK DEPARTMENT OF AIR RESOURCES

MR. GERSON: The New York City Department

of Air Resources has long recognized the hazardous nature

of airborne asbestos, beryllium and mercury. Our air

code was the first in the country to set specific limita-

tions on emissions of these three pollutants. Furthermore,

we were the first agency to regulate and ban the open spraying of asbestos containing insulation. Needless to say, this department fully supports the efforts of the Federal Government to establish meaningful national standards.

It is our intention to submit a written report to the Environmental Protection Agency in which we will detail information relating to:

First, the measurement techniques developed by us, in conjunction with the Mt. Sinai School of Medicine, to determine ambient levels of asbestos particulates, and

Second, data we have collected on ambient levels of beryllium and mercury in the city.

We hope that the information will prove useful to you in coming up with final ambient levels, emission limitations, and measurement techniques relating to asbestos, beryllium and mercury.

Thank you very much.

MR. MEGONNELL: Thank you Mr. Gerson. I think I just found a way for <sup>Dale</sup>Bill Slaughter legitimately to spend a night in New York City.

(Laughter.)

He'll be down to consult with you.

Could you briefly summarize the specific limitations you have on these three compounds?

MR. GERSON: Yes, certainly. Our Air Code which became effective on August 25, 1971, attacked beryllium, mercury, asbestos and cadmium. We set an emission limitation on each of these.

Cadmium was .15 micrograms per cubic meter; beryllium was 10 nanograms per cubic meter; mercury .1 micrograms or 100 nanograms per cubic meter, and asbestos 27 nanograms per cubic meter.

In addition, effective February 25th or six months after the effective date of this code, the burning of material containing asbestos is banned in New York City. In the meantime, we have restrictions against tarpaulins, housekeeping brooms, etc., wherever asbestos is used --

MR. MEGONNELL: These are emission standards?

MR. GERSON: These are emission standards.

MR. MEGONNELL: I would be interested in the measurement method you used for asbestos.

MR. GERSON: I am not very conversant with that. Dr. Ferrand, who is the head of our bureau of technical services, worked with the environmental services laboratory at Mt. Sinai Hospital and developed a standard

method for measuring ambient levels of asbestos. He is preparing a paper on that for publication, which is one of the documents we intended to submit. He is available today for discussion on that. It is very reproducible, very good, and very difficult to run without very trained personnel. We have measured beryllium, and to the best of my knowledge, it has always been below the limits of detection of our apparatus. The data on mercury is still very sparse.

MR. MEGONNELL: The asbestos system gives you quantitative answers?

MR. GERSON: That is correct.

MR. MEGONNELL: Is it electronmicroscopy?

MR. GERSON: I am not sure.

MR. MEGONNELL: We will await your official comments on these.

MR. GERSON: Or you can meet with Dr. Ferrand at any time, or Dr. Selkoff at Mt. Sinai.

MR. MEGONNELL: Thank you very much, Mr. Gerson.

MR. GERSON: May I ask you two questions?

MR. MEGONNELL: I don't know if we will answer them.

MR. GERSON: We have had some problems

with Consolidated Edison and they had expressed an

interest as to how you intend to apply the beryllium

and mercury standards to a fuel oil in a fossil fuel

plant. What is your current thinking?

MR. MEGONNELL: We just can't answer it

at this time. We are aware that these are sources of

mercury and beryllium. We don't know how much. We have

sampling procedures underway in order to quantitate this.

If it appears to be a sizable problem I am sure there will

be a proposed amendment to our regulations.

MR. GERSON: I think if you are interested

we have analyzed Con Ed fuel for beryllium mercury. They

have analyzed it. I can get that data for you on the

fuel oil they are burning which is currently between .3

and .9 percent sulphur.

MR. MEGONNELL: Mr. Slaughter is nodding

his head. I think he would very much appreciate having it.

We do have some analyses from around the country, but

every little bit helps.

MR. GERSON: Do you have any on the low

sulphur fuels?

MR. MEGONNELL: No.

STATEMENT OF  
DEPARTMENT OF PUBLIC HEALTH  
BUREAU OF AIR QUALITY CONTROL OF THE  
COMMONWEALTH OF MASSACHUSETTS

MR. GERSON: What are your feelings on the contribution of asbestos from brake linings to the general ambient problem?

MR. MCGONNELL: I have tried to explore that in some of the questioning here today, because it is something that is constantly, shall I say, brought to our attention. I read some reports where it probably is not a problem because in the heat generation something happens to the asbestos to turn it to a different non-toxic or relatively non-toxic form. That was indeed the testimony<sup>ed</sup> present by the Johns-Manville people this morning. I think there is a public health study, I don't know if there are any other studies underway, but I suspect there may be. Thank you very much.

I have a statement from the Bureau of Air Quality Control, Commonwealth of Massachusetts, Department of Public Health, which will be inserted into the record as it read.



differ widely.

Until standard sampling methods can be developed and national emission standards established, it is absolutely essential that operations be prohibited where asbestos dust emissions cannot be satisfactorily controlled. Satisfactory controls should be required on all operations where a potential for asbestos emissions exists.

This should be our national policy followed by adequate federal regulation and enforcement.

The serious adverse health effects of the inhalation of beryllium have been well documented. The relationship between exposure levels and onset of disease have been well established. The air sampling methods and the engineering control techniques and equipment have been developed, and have been and are presently in use.

The remaining necessary steps yet to be taken is the adoption and enforcement of national emission standards.

Mercury can be found in our environment in the air we breathe, the water we drink and the food we eat. It is extremely mobile and can be readily transferred from one medium to another. The amounts of mercury in air, water and food must be regulated to effectively

This statement reflects the policy of the Department of Public Health, Bureau of Air Quality Control of the Commonwealth of Massachusetts and is presented on behalf of the Governor of the Commonwealth.

Although the state has no asbestos mining or milling industries, there has been long experience in manufacturing and fabricating industries where asbestos is used. Even with strict industrial hygiene control requirements, occupational asbestosis cases have been reported within the past few years. The more recent application techniques of spraying asbestos fireproofing and insulation has increased the risk of asbestosis, not only among the worker population but to the general public as well. This unnecessary exposure should not and cannot be tolerated.

The association between mesothelioma and non-occupational exposure to asbestos in the South African mining area, clearly indicates air pollution control measures are necessary to protect the public health.

The time span between exposure and subsequent effects can be a matter of years, the effects are extremely serious and the dose response relationship is unclear. To this we must add that air sampling and evaluation methods

control human absorption of mercury. Massachusetts recent experience with mercury contamination in shellfish (clams, quohogs, lobster) was given national attention.

The sampling methods and engineering control techniques are available at present to control most sources of mercury emissions and should be utilized at the earliest possible date. The establishment and enforcement of national emission standards are essential to adequately control mercury emissions.

Although national emission standards and control techniques should be adopted, the states should have the authority to adopt more stringent requirements where necessary to maintain adequate air quality and to prevent a public nuisance.

It is suggested that EPA - Office of Air Programs be guided in its future consideration of what is a hazardous pollutant by the stated and defined philosophy that prevails when considering ionizing and non-ionizing radiation. This philosophy dictates -- in its simplest terms -- that any such radiation exposure of the public that is controllable shall be eliminated. This statement is most probably an oversimplification but it has been and it is a good yardstick to follow when air

pollution control regulatory officials must deal with unknown or scantily supported health effects of hazardous pollutants.

MR. MEGONNELL: Our next statement is by Mr. E.C. Bratt, of H.K. Porter Company, Incorporated.

STATEMENT BY

E. C. BRATT

GROUP GENERAL MANAGER

ASBESTOS

H. K. PORTER COMPANY, INC.

MR. BRATT: This statement is not directed to the question of whether or not asbestos is a hazard to health, but rather to the making of a standard. I concur with previous witnesses that asbestos is a hazardous pollutant under certain occupational conditions and that the Administrator is correct in thinking to control its emission.

I would like to state the position of my company. Namely, that we can, and will live with any

reasonable standard promulgated by the Federal Government. Our concern, since we are manufacturers of friction products and Asbestos Textiles, as well as miners of raw

material, is that various agencies of the government will operate in their individual jurisdiction without regard for a possible conflicting viewpoint of another agency. We strongly urge the government bodies involved, beginning with Environmental Protection Agency, to coordinate their efforts so that we, in industry, have one set of guidelines, one standard to follow.

Thank you.

MR. MEGONNELL: Thank you, Mr. Bratt. Thank you for several things. That statement is the epitome of brevity.

(Laughter.)

When you mentioned friction products, does that include brake linings?

MR. BRATT: Yes, it does.

MR. MEGONNELL: Do you have an opinion on the question of the last gentleman who just asked about the possible hazards of asbestos from brake linings?

MR. BRATT: I have an opinion but it is not backed by any scientific data. I think you are aware it is still being accumulated. I understand there are studies underway, but if you ask my personal opinion, I have to agree with the testimony that the representatives

of Johns-Manville gave here that it is insignificant.

MR. MEGONNELL: Well, I think we share your desire for equitable and uniform standards and enforcement as far as possible. If I read the intent properly, I think we want it. I think it is reflected in various places throughout the Clean Air Act. I also think it will be EPA's purpose through its grant program, technical assistance and the delegation authority which we have under the Act to promote reasonable and uniform standards and enforcement. I should point out, however, that what may be adequate control in one point may not necessarily be in another place. This is recognized in the Act. If it is necessary for a variety of reasons, the federal law does provide for tighter state or local standards.

It is our contention, just as you expressed, to promote as well as we can the uniform<sup>ity</sup> of standards and to prevent controversy. Thank you very much.

The last witness is Mr. Robert Cusumano from Nassau County.

If there is anybody else who would like to speak we would certainly like to have that fact known.

STATEMENT BY  
ROBERT D. CUSUMANO  
AIR POLLUTION CONTROL ENGINEER III  
DIRECTOR  
BUREAU OF AIR POLLUTION CONTROL

MR. CUSUMANO: The Nassau County Health Department's Bureau of Air Pollution Control favors the enactment of federal emission standards for hazardous air pollutants.

The standards, test methods, and accompanying literature published by the Environmental Protection Agency will greatly assist us in performing our role toward attaining compliance with these regulations throughout the County of Nassau.

With our available resources, we shall, in cooperation with New York State Department of Environmental Conservation and the EPA endeavor to insure that our establishments comply with the proposed emission standards.

While the proposed regulations would apply to only a few categories of sources in the County of Nassau, the following specific comments will delineate areas of concern. Furthermore, the writer will recommend to County government that EPA's proposed emission standards

and any similar enactments by the New York State Department of Environmental Conservation be incorporated in proposed revisions of our Local Law No. 1-1967, in order to permit a more solid, legal basis for local activity in this important area of air pollution control.

Asbestos:

There are no industries in the County of Nassau engaged in the mining, milling or processing of asbestos ore and none known to be manufacturing products in which asbestos is a constituent. The application of asbestos compositions to construction steel for fireproofing, and fabrication of asbestos products such as brake linings have been or are still being conducted in the county. Recently, a large construction firm advised us of their plans to spray asbestos-containing materials in the structure of a new building in Nassau County. In light of the proposed Part 196 of New York State's air pollution control rules banning asbestos spray-coating operations (see Appendix A) and your proposed national emission standards also prohibiting this practice, we were successful in convincing the applicant by voluntary means not to conduct asbestos spray-coating but to use an alternate material. Needless to say we strongly support the passage



of EPA prohibitions of asbestos spray operations outlined in Section 61.22(e) of sub part B.

Beryllium:

There are no known industries in Nassau County engaged in the extraction, mining, milling or processing of beryllium metal or its ores. In 1971 a survey of Nassau shops machining beryllium metals and alloys revealed that of 375 establishments contacted, 15 indicated that they do perform metal working operations on beryllium or its alloys. Of the latter, 4 had sophisticated control systems, 5 processed beryllium copper with no emission controls and 6 were indefinite on the survey form as to whether they had controls or not.

Additional investigations are necessary since 37% of the total number of firms contacted did not reply to our survey forms. (see Appendix B).

In passing, our urgency in this matter is noted on the attached blank form as staff instructions from the Chief of our Engineering Section were to pursue this important matter immediately. This survey is being conducted in cooperation with the New York State Department of Labor whose Division of Industrial Hygiene has responsibility for evaluating these facilities. One recommendation I would

like to make is that any air cleaning device for metal working operations such as a dust bag filter, "absolute filter," or water scrubber, have an interlocking signal device to warn of equipment failure. This would eliminate the possibility of having defective equipment operate up to three months before being found to have such defects.

Mercury:

There are no known operations in Nassau processing mercury bearing ores or producing mercury salts. There are, however, several instrument companies using mercury metal in barometric and thermometric systems. The disposal of broken apparatus, instruments, and containers used for mercury should be controlled. The present practice of some firms is to discard this equipment with the rest of their waste to be incinerated. Incineration temperatures exceed the boiling point of mercury 674°F and mercury oxide fumes would thus be emitted. According to the National Air Pollution Control Administration Publication No. APTD 69-40, the categories of "general laboratory use" and "industrial and control instruments" consumed 5.9 thousand flasks of mercury in 1966. Standards for disposal of recycling of empty containers and discarded equipment would reduce the possibility of mercury entering the air

in this manner.

While we feel that subpart E has little applicability to firms within the county, it is recommended that it be expanded to include the aforementioned disposal problems.

(Appendix A)

STATE OF NEW YORK

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Subchapter A

Prevention and Control of Air Contamination and Air Pollution

PART 196

Asbestos-Containing Surface Coating Materials

(Statutory authority: Environmental Conservation Law,  
Sections 14 and 15)

Sec.

196.1 Applicability

196.2 Prohibition

Section 196.1 Applicability. This Part shall apply throughout the State of New York.

Section 196.2 Prohibition. No person shall engage in or allow surface coating by the spraying of asbestos or asbestos-containing materials.

NASSAU COUNTY STATEMENT REGARDING  
PART 196 OF THE AIR POLLUTION  
CONTROL RULES PROHIBITING  
ASBESTOS SPRAY-COATING

The Bureau of Air Pollution supports and urges the enactment of Part 196 of the New York State Air Pollution Control Rules prohibiting asbestos spray-coating. While a cursory review of contractors and buildings under construction in Nassau County revealed no reliance on the spray application of asbestos insulation, some local contractors have indicated that they did utilize the practice in the past but have since substituted other techniques. In spite of this reassurance, we are concerned that there could be a return to the practice as Nassau buildings increase in size and/or outside contractors become involved.

In the First Annual Report of the Council on Environmental Quality, transmitted to Congress in August, 1970, it was indicated - - - - "Asbestos, long recognized as an occupational hazard, is increasingly present in the ambient air because of its use in construction materials, brake linings, and other products. Long exposure in industry produces the lung-scarring disease,

asbestosis. On the other hand, mesothelioma, a type of lung cancer associated almost exclusively with asbestos exposure, does not appear to be associated only with heavy or continued exposure."

The U.S. Environmental Protection Agency, in an annotated bibliography has reviewed the technical literature concerned with asbestos and air pollution. In one paper by Cuthbert, entitled "The Community Hazards of Asbestos," the review states - "the inhalation of asbestos is far more dangerous than is generally recognized by the public, since even a transient period of exposure can lead to disease and death many years later. - - - While the asbestos industry has taken energetic measures toward the prevention of classical forms of asbestosis by dust elimination in its plants - - - such prophylactic measures have not prevented the gradual long-term development of cancer in persons who come into occasional, slight, or temporary contact with asbestos. This group certainly included wives of asbestos workers and all persons living within 1.5 km (approximately 1 mile) of an asbestos plant." It further indicates that carpenters and construction workers for example, "do not realize their relatively brief contact sawing or handling asbestos materials can lead to lung

cancer many years later."

Furthermore, other surveys show the presence of asbestos bodies in the lungs of those not occupationally exposed to asbestos, particularly in urban areas. Recently, the Long Island Press quoted the 27 volume report by Litton Industries, completed in 1970 for the National Air Pollution Control Administration.

"Asbestos is an air pollutant which carries with it the potential for national or worldwide epidemic of lung cancer - - - - . Asbestos bodies have been observed in the lungs of residents of Miami and San Francisco and will probably be found in the people of every large city - - - -. The effects of the asbestos being inhaled today may not be reflected in the general population until the 1990's or the next century."

We commend the State for initiating this first step toward the elimination of asbestos particulates from the air. However, as alluded to above, there are other significant sources of airborne asbestos that may be as potentially hazardous as spray-coating and these may eventually require regulation also. While the Bureau of Air Pollution Control has initiated investigations concerning local control of a number of toxic agents, including

asbestos, the statewide occurrence of sources of asbestos make it advisable for the State to formulate further regulatory controls as necessary.

MR. MEGONNELL: Thank you, Mr. Cusumano.

I think you made a couple of pretty good suggestions there. I don't know if our staff has considered them or not. I don't know if these interlocking signal devices are available, but I think it is worthy of consideration. Thank you very much.

To the best of my knowledge, that concludes the list of persons who have requested to be heard. As I announced at the beginning of the hearing, the record will be kept open for one week and any communication postmarked before the close of business on January 25, 1972, or postmarked before midnight on January 25, 1972, will be accepted for reproduction in the record, or if it is too voluminous it will be accepted as an exhibit to the record. I want to thank the participants for their

I thought, very good and well prepared and carefully

presented statements. I want to thank all of you for your attention and decorum during the hearing, and I

want to remind you also that comments on the proposal

may be submitted in accordance with the Federal Register



# NASSAU COUNTY DEPARTMENT OF HEALTH

240 OLD COUNTRY ROAD, MINEOLA, N. Y., 11501

Jos. H. Kimmman, M.D., M.P.H.  
Commissioner  
George H. Sommer, P.E.  
Ass't. Commissioner  
Environmental Health

10/17/71

*Ford*  
*Please get on this*  
*immediately*  
*Bruce*

Gentlemen:

The County is conducting a survey of all firms who have performed or who are in a position to perform metal working operations on beryllium metal or its alloys. We shall appreciate your completing this form and returning it to us in the enclosed envelope within the next two weeks.

Very truly yours,

*B L Calder*

Bruce L. Calder, P.E., M.Ch.E.  
Chief, Engineering Section  
Bureau of Air Pollution Control

- 
- |  |                              |                             |
|--|------------------------------|-----------------------------|
| 1. Has your firm performed machinery operations in the past on beryllium or its alloys?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. Do you now engage in such operations?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. a) If orders were available, would you welcome such business?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| b) If "yes" would you be willing to install special air pollution control equipment?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. What facilities do you now have for handling emissions from operations involving beryllium metal and/or its alloys? (Describe such facilities). |                              |                             |

Signature

Title

Date



TABLE 1  
INTERLABORATORY ANALYSIS COMPARISON FOR BERYLLIUM

Particulate matter samples were collected from the inside wall of two exhaust stacks used on beryllium processes. Three replicate samples were prepared from each collected sample. The replicate samples were analyzed by three laboratories using atomic absorption spectrometry. The beryllium analysis results and relative standard deviation between laboratories are shown below.

Description		EPA	Kawēcki Berylco Indus. Inc.	Brush Beryllium Company	Relative Standard Deviation In Percent
Sample collected from chemical resistant stack (wet stack)	Analysis Percent by wt.	1.58	1.30	1.32	11.2
Sample collected from metal stack (dry stack)	Analysis Percent by wt.	2.21	2.47	2.22	6.4

TABLE 2  
INTERLABORATORY ANALYSIS COMPARISON FOR MERCURY

Samples of mercury in iodine monochloride were collected from chloroalkali process streams using Method 1 (determination of mercury in particulate and gaseous emissions from stationary sources). Selected component portions of Method 1 test train representing various mercury concentrations were prepared in replicate for analysis by three laboratories. The mercury analysis procedure described in Method 1 was used by each laboratory. The mercury analysis results and relative standard deviation between laboratories are shown in the attached table.

---

TABLE 2  
INTERLABORATORY ANALYSIS COMPARISON FOR MERCURY

Analysis Code	Description	EPA	BSAF Wyandotte Corp. (1)	Oak Ridge National Laboratory	Relative Standard Deviation In Percent
		8-20-71 (2)	11-15-71 (2)	10-7-71 (2)	
		Analysis Results $\mu\text{g/ml}$			
EPA-1-Hg	1st Impinger (PE-H-Pa-I)	80	84	81.7	2.5
EPA-2-Hg	2nd Impinger (PE-H-Pb-I)	16.2	11.2	14.7	18.3
EPA-3-Hg	3rd Impinger (PE-H-Pc-I)	0.45	0.48	0.83	36.0
EPA-4-Hg	Glassware wash (PE-H-Pd-I)	4.2	4.2	5.05	5.4
EPA-6-Hg	Probe wash (PE-H-Pg-I)	144.	126.	156.	10.6
EPA-7-Hg	Overall last wash (PE-H-Pi-I)	0.31	0.36	0.40	17.9
EPA-8-Hg	1st Impinger (PE-H-Pa-III)	188.	148.	198.	14.9
EPA-9-Hg	1st Impinger (PE-V-Pa-3)	450.	481.	408.	8.2
EPA-12-Hg	Known Concentration of mercury in ICl solution	(3)	(4)	297	1.0 (5)

(1) Average of several values reported

(4) None Reported

(2) Analysis date

(5) Percent error

(3) Known concentration prepared by EPA is  
300  $\mu\text{g/ml}$

TABLE 3

## PRECISION OF METHOD 1 ANALYSIS FOR MERCURY

Samples of mercury in iodine monochloride were collected from chloro-alkali process streams using Method 1 (determination of mercury in particulate and gaseous emissions from stationary sources). Selected component portions of Method 1 test train representing various mercury concentrations were prepared in replicate for analysis by three laboratories. The results of this interlaboratory comparison are reported in Table 2. Two laboratories reported data on the precision of the analysis. The results on precision are reported as relative standard deviation in percent in the table attached.

---

TABLE 3  
PRECISION OF METHOD 1 ANALYSIS FOR MERCURY

Analysis Code	Description	EPA						BASF WYANDOTTE CORP.		
		1-11-72 <sup>(1)</sup>			12-20-71 <sup>(1)</sup>			11-12-71 and 11-15-71 <sup>(1)</sup>		
		Number Observations	Avg. Hg $\mu\text{g/ml}$	RSD (2) in Percent	Number Observations	Avg. Hg $\mu\text{g/ml}$	RSD (2) in Percent	Number Observations	Avg. Hg $\mu\text{g/ml}$	RSD (2) in Percent
EPA-1-Hg	1st Impinger (PE-H-Pa-I)	10	78	5.4	7	80	8.0	13	83.6	11.8
EPA-7-Hg	Overall last wash (PE-H-Pi-I)	--	--	--	-	--	--	9	0.36	16.1
EPA-8-Hg	1st Impinger (PE-H-Pa-III)	13	200	13.5	-	--	--	--	--	--
EPA-9-Hg	1st Impinger (PE-V-Pa-3)	10	475	6.2	-	--	--	--	--	--

1) Analysis date

2) Relative Standard Deviation

announcement outside this hearing procedure until March 6, 1972.

Thank you very much. The hearing is now adjourned.

(Thereupon, at 3:20 o'clock P.M., the hearing was adjourned as above set forth.)

STATEMENT OF  
DARRYL J. VON LEHMEN  
ENVIRONMENTAL PROTECTION AGENCY

Mr. Presiding Officer, my name is Darryl J. von Lehmen. I am Deputy Chief, Source Sample and Fuels Analysis Branch, Division of Atmospheric Surveillance, National Environmental Research Center, Environmental Protection Agency, Research Triangle Park, N.C. I wish to enter into the record the following information on the analysis methods proposed for beryllium and mercury.

An interlaboratory comparison for beryllium using Method 3 was conducted on samples obtained from the inside wall of two exhaust stacks used on beryllium processes. The three laboratories participating in the interlaboratory analysis comparison were Kawecki Berylco Industries, Inc., Brush Beryllium Co. and the Environmental

Protection Agency. The analysis results and relative standard deviation between laboratories are submitted on Table 1. <sup>(P-163E)</sup> The maximum relative standard deviation between laboratories was 11.2 percent.

An interlaboratory comparison for mercury using Method 1 was conducted on samples collected from chloroalkali process streams. The three laboratories participating in the interlaboratory comparison were BASF Wyandotte Corp., Oak Ridge National Laboratory and the Environmental Protection Agency. The analysis results and relative standard deviation between laboratories are submitted as Table 2. <sup>(pp. 163 C + D)</sup> The relative standard deviation for samples containing significant mercury, namely 80 or more micrograms mercury per milliliter of iodine monochloride, was 2.5, 8.2, 10.6 and 14.9 percent.

Two laboratories participating in the interlaboratory comparison for mercury determined their laboratory precision for Method 1. The analysis results and relative standard deviation for precision are submitted as Table 3. <sup>(pp. 163 E + F)</sup> BASF Wyandotte Corp. reported a relative standard deviation of 11.8 percent for precision at a reported concentration of 83.6 micrograms of mercury per milliliter of sample. The Environmental Protection Agency

determined a relative standard deviation of 5.4 and 8.0 percent for precision at a reported concentration of 80 and 78 micrograms of mercury per milliliter of sample respectively.

Based on the interlaboratory comparison data and the interlaboratory precision data, the Environmental Protection Agency considers the methods of analyses proposed for beryllium and mercury to be adequate.

\* \* \*



(The following statement was submitted for inclusion in the record:)

JOHNS-MANVILLE  
Research & Engineering Center  
P.O. Box 159  
Manville, N. J.

January 21, 1972

Administrator, Env. Protection Agency  
Attn: Mr. William H. Megonnell  
Presiding Officer, Hazardous  
Emission Standards Hearings  
Room 17-70  
5600 Fishers Lane  
Rockville, Maryland 20852

Dear Mr. Megonnell:

In the course of my testimony on behalf of Johns-Manville at the public hearing held January 18 in New York City, I stated, in response to a question on asbestos emissions from brake linings, that the total amount of chrysotile asbestos fiber emitted as a result of brake lining wear each year throughout the United States might be approximately 1,500 tons. This estimate was a rough calculation I made during the hearing based on my recollection of the quantity of asbestos used in friction materials in the United States.

After the hearings, I checked my recollection of the quantity of fiber used in friction materials, and I found that I had used the wrong figure. As a result, my estimate of the total quantity of asbestos fiber released annually from brake linings was too high. I would, therefore, like to correct my estimate for the record and outline the assumptions I have used in making it.

Based on Bureau of Census data and our own production data, we estimate that 30,000 to 35,000 tons of asbestos are used each year in the United States in the manufacture of brake linings. It seems reasonable to assume that this figure also is a good approximation of the amount of asbestos fiber which is "consumed" in one way or another in actual usage of brake linings on vehicles. J. R. Lynch of the U. S. Public Health Service reported in his paper on "Brake Lining Decomposition Products" that in most cases of normal braking service less than one per cent of the asbestos present in brake linings is released as asbestos fiber. More than ninety-nine per cent of the asbestos in the linings is decomposed by the heat of friction into amorphous material and non-fibrous crystalline materials. Our own work has identified the crystalline decomposition materials as forsterite and enstatite. So far as I am aware, these

materials have no significant toxic effects.

If we take the figure of 35,000 tons of asbestos per year as the amount "consumed" in brake linings and assume that 1 per cent of that is released from the linings as asbestos fiber, then the amount of fiber released per year in the United States is 350 tons. Even this may be a high figure since it assumes that all brake linings are worn down to zero weight in service. In actual practice, brake linings are replaced when about 2/3's of their mass has been worn away.

Although the estimate above could be changed by modifying the assumptions concerning the quantity of fiber consumed in brake linings and the percentage of asbestos released as free fiber, I believe further experimental work will show that subsequent modifications in the assumptions will be relatively minor. I think the estimate of 350 tons of asbestos fiber released per year in the United States from the wear of brake linings is the right order of magnitude. When one considers that not all this released fiber is airborne for any extended period of time, and that the material which is airborne is subject to a high degree of dilution and subsequent "washing" from the atmosphere, it is difficult to believe that it constitutes a significant source of air pollution.

If you have any questions concerning my estimates or assumptions, please do not hesitate to contact me.

Sincerely yours,

/s/ F. L. Pundsack  
F. L. Pundsack  
Vice President,  
Research & Development

oo0oo

5600 Fishers Lane  
Rockville, Maryland 20852

JAN 27 1972

cc: Al. Zimmer  
w/cpy of incoming

Mr. F. L. Pundsack  
Vice President  
Research & Development  
Johns-Manville  
P.O. Box 159  
Manville, N. J. 08835

Dear Mr. Pundsack:

This will acknowledge receipt of your letter of January 21, 1972, clarifying your testimony at the hearing in New York City.

Your letter has been forwarded to the reporter for inclusion in the record.

Sincerely yours,

William H. Megonnell  
Director, Division of Stationary  
Source Enforcement

E.E. Reich/ms/1/27/72/34100/Rm 17-70/Parklawn

SSR 1/27

# Johns-Manville

Research & Engineering Center

P. O. Box 159  
Manville, N. J. 08835  
(201) 722-9000

January 21, 1972

Administrator, Env. Protection Agency  
Att: Mr. William H. Megonnell  
Presiding Officer, Hazardous  
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January 21, 1972  
Page 2

Mr. William H. Megonnell  
Administrator, EPA

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If you have any questions concerning my estimates or assumptions, please do not hesitate to contact me.

Sincerely yours,



F. L. Pundsack  
Vice President, Research & Development

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